708A DUAL BEAM OSCILLOSCOPE

Instruction Manual

Serial No.

FAIRCHILD

INSTRUMENTATION

A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

MP MASTER

MA30000

TYPE

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SCIENTIFIC INSTRUMENT DEPARTMENT

750 Bloomfield Avenue, Clifton, New Jersey, U.S.A.

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Manual No. 6704 7151

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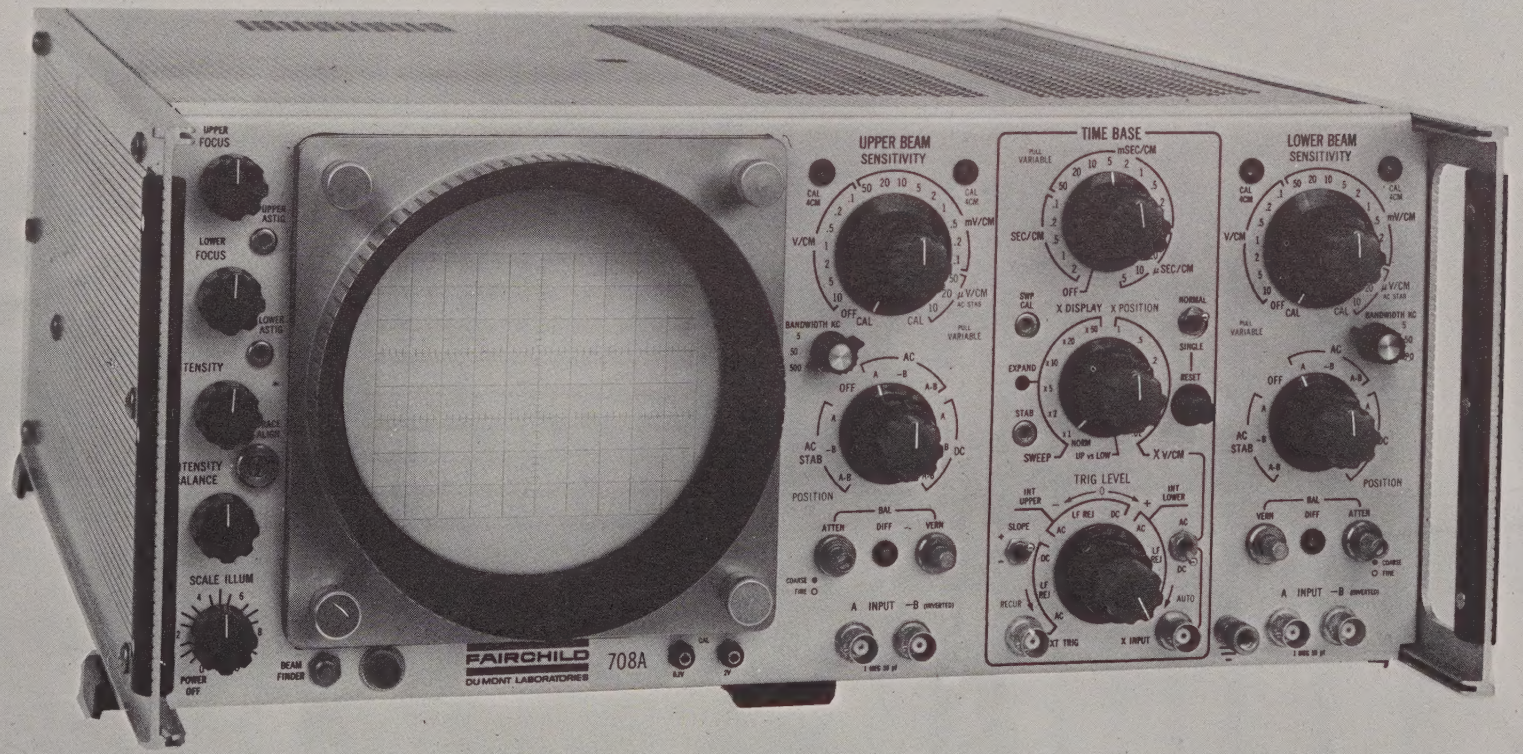


FIGURE 1-1. TYPE 708A HIGH GAIN DUAL BEAM OSCILLOSCOPE

SECTION 1

TECHNICAL SUMMARY

1-1. INTRODUCTION

The Fairchild 708A Oscilloscope is a 10 uV/CM dual beam oscilloscope featuring simple panel controls for total ease of operation. Its unique electrometer type input stage gives exceptional amplifier position stability. The side bandwidth of this instrument assures that it can be used with many laboratory and field maintenance applications, while dc amplification provides that the lowest frequency portions of signals will be faithfully reproduced.

The Type 708A has extended measurement capabilities and is easy to use. Its universal type cabinet is suitable for laboratory and system rack mount applications. Typical applications include indicator for transducers, electro-medical research, servo work, and general purpose work requiring a dual beam display without time sharing. The Type 708A has selectable bandpass in three switch settings (500 Kc), (50 Kc) or (5 Kc) for maximum capabilities at the high sensitivity.

1-2. FEATURES

- No time sharing, dual gun CRT
- Two identical vertical amplifiers
- 10 uV/CM sensitivity
- DC or AC stabilized amplifiers
- 6 X 10 cm viewing area each beam
- 5 Kv aluminized high intensity CRT
- Universal bench and 7-inch rack mount
- Selectable bandpass
- Silicon transistors and ac stabilization assure maximum drift stability
- CRT deflection is driven directly from transistorized amplifiers

1-3. LIST OF RECOMMENDED ACCESSORIES

Type or Part Number	Description
	ATTENUATOR PROBES (10:1 terminated in BNC type connector)
4290	10M, 10 pf; 4-ft cable
4298	10M, 14 pf; 8-ft cable
4299	10M, 12 pf; 6-ft cable
	COLOR FILTERS
4800 5861	Amber for P7 screen
4800 5862	Blue for P11 or P7 screen
4800 5863	Green for P2 & P31 screen
4800 6101	Neutral filter, circularly polarized
	SCOPE TRAVELER & RACK SLIDES
7030	Top tray: 17-3/4 inches X 22-1/2 inche 32-1/2 inches from floor
7085	Rack slides: detented tilt mechanism
7086	Rack-mounting ears
	VIEWING ACCESSORIES
276C	Viewing hood made of molded rubber
7035	Round light shield to reduce glare and reflection; does not have a molded eye piece
	CAMERAS
450/450A 453/453A	Oscilloscope Record Camera with suitable accessories
	MISCELLANEOUS
7011	Tool Kit
7012A	Input Capacitance Standardizer
7080	UG-1090/U BNC to binding post
7081	Adapter connector, BNC Type UG-274/U
7084	UG-636/U C male to BNC female
7088	Z-axis modulation modification kit
7089A	Rear access connector modification kit

1-4. TECHNICAL SUMMARY (Specifications)

The electrical characteristics of the Type 708A Dual Beam Oscilloscope are listed in the Performance Specification which follow.

SPECIFICATIONS

UPPER & LOWER BEAM VERTICAL-DEFLECTION SYSTEM

Bandwidth

Direct Coupled: DC to 500 Kc; down 3 db at 500 Kc

Capacitively Coupled: Low frequency cutoff is 3 cycles

Rise Time: 0.7 microsecond with less than 2% overshoot

Sensitivity

10 uV/CM to 10 V/CM in 19 steps of 1, 2, and 5 sequence accurate to within +3%. An OFF position is included for dc balancing

The PULL VARIABLE control permits 2.5 to 1 continuous sensitivity adjustments between the attenuator steps and extends the 10 V/CM range to 25 V/CM. The VARIABLE knob is provided with a push-pull switch to facilitate calibration check; the pulled knob indicates uncalibrated vernier gain setting

Input Impedance

1 megohm, constant within ±3% at all attenuator settings for single-ended operation; nominally 50 pf ±10%; constant within ±5% from range to range. Coupling may be direct or through capacitor of 600-volt rating to amplifier

Input Connectors

BNC connectors are provided for selection of one of two individual channel single-ended inputs, or dual use for differential input; choice of ac, dc, or ac stab coupling

Balanced Input

On all ranges input impedance is 2 megohms shunted by less than 40 pf

Common Mode Rejection Ratio

Nominally 5000:1. Applies to 20 mV/CM through 10 V/CM attenuator ranges only. Attenuator accuracies are additive on all other ranges. Measured at 60 cycles and not controlled at higher frequencies

Common Mode Maximum Signal

Common mode signal must not exceed 6 volts peak-to-peak ac or +3 volts dc on 20 mV/CM to 10 V/CM ranges; must not exceed 60 volts peak-to-peak on 20 mV/CM to 0.1 V/CM ranges; must not exceed 300 volts peak-to-peak on 0.2 V/CM to 10 V/CM ranges

Phase Shift

Vertical and horizontal amplifiers are identical. At maximum gain, the phase shift between the orthogonal systems is adjustable to ±1° at any point from dc to 100 Kc. When adjusted to 0° at 100 Kc, the phase shift differential is ±2° from dc to 150 Kc

SPECIFICATIONS (Continued)

AC Stab LF Cutoff

VOLTS/CM Range	Nominal Cutoff Frequency
10 uV to 50 uV	5 cycles
0.1 uV	4 cycles
0.2 uV	2.5 cycles
1 mV to 10 V	2 cycles

HORIZONTAL-DEFLECTION SYSTEM

Bandwidth

Direct Coupled: DC to 500 KC; down 3 db at 500 KC

Capacitively Coupled: Low-frequency cutoff is 5 cycles

Rise Time: 0.7 with less than 2% overshoot

Sensitivity

20 mV/CM to 1 VOLT/CM in 6 steps of 1, 2, and 5 sequence; accurate to within 3%

Input Impedance

1 megohm paralleled by 50 pf

X-Y Plotting

In the Upper Beam vs Lower Beam mode the Lower Beam amplifier is connected to the horizontal deflection plates for a 10 uV/CM X-Y plotter

TRIGGERING SYSTEM

Triggering Capabilities

Triggering from internal, external and line sources on either positive or negative slopes is attainable. Automatic triggering is also available with internal, external or line sources

Internal Trig Sensitivity

Signals will trigger from 4 mm of vertical deflection on driven sweep. When in the auto sync mode, less than 3 mm are required for triggering from dc to 500 KC

Internal source is available from both upper or lower beam deflection amplifiers

External Trig Sensitivity

Triggering is achievable from DC to 500 KC at a signal level of 500 millivolts peak-to-peak, 400 millivolts peak-to-peak are required when in the auto sync mode

Automatic Triggering

When in the automatic mode of operation, the sweep will free run at a 50-cycle rate in the absence of a trigger signal

Trigger Level

A range of ±10 volts for external trigger input, or 1.5 times full scale on internal triggering

SPECIFICATIONS (Continued)

TRIGGERING SYSTEM (Continued)

AC Coupling

High-pass filter with low-frequency cutoff of 80-cycles

DC Coupling

Direct coupling is provided to optimize trigger sensitivity when very slow waveforms are applied; to maintain the initial reference position of the trace with respect to the graticule at a given trigger level setting when on internal source; and to avoid trigger point variations due to random repetition rate trigger signals

LF Reject Coupling

Differentiated trigger input; high-pass filter is provided to reject hum and low-frequency amplitude modulation; low-frequency cutoff nominally 15 Kc. Signals should rise or fall in less than 100 uSEC to pass the LF reject filter

TIME BASE SYSTEM

Sweep Range

Calibrated linear sweep rates from 5 uSEC/CM to 2 SEC/CM in 18 steps of 1,2, and 5 sequence. An OFF position is provided

The PULL VARIABLE control provides a continuous uncalibrated range of sweep rates between ranges and extends the 2 SEC/CM range to 6 SEC/CM (60 seconds full scale)

Sweep Accuracy

Normally within 2%; always within 3% (averaged over the centered 8 cm portion of the CRT screen)

Sweep Expansion

The sweep may be expanded about center of screen from 1 to 50 times in six steps of 1, 2, and 5 sequence; extends fastest sweep rate to 100 nanoseconds/cm

Expansion Accuracy

±5% for sweep rates up to 1 microsecond/cm; ±10% at faster sweep rates to 100 nanoseconds/cm

Expanded Sweep Positioning

Sufficient to position any full scale portion of the expanded trace on the screen

Single Sweep

A single sweep mode is provided. Push button rearming switch and rearm indicator light are located on the front panel. Remote electrical rearming is available through BNC connector on rear of unit. Screen is blanked after each sweep

Electronic Shutter

Controlled exposure brightening for multiple X-Y displays through use of triggered sweep. This feature may be switched out by setting the sweep to the OFF position or by using SINGLE sweep mode

SPECIFICATIONS (Continued)

CATHODE-RAY TUBE DATA

Type

F7080-0-P31, flat faced 5-inch dual gun, tight tolerance, high resolution cathode-ray tube is normally supplied

The two electron guns have independent vertical deflection plates and common horizontal deflection plates. Each gun has a 6 X 10 cm viewing area with a 4 cm overlap

Optional Phosphors

P7 phosphor for long persistance low frequency or transient observation; P11 phosphor for photographic use; and P2 phosphor for combination visual and photographic use. Other phosphors are also available on special order

Accelerating Potential

5000 volts

Graticule

Engraved edge-lit graticule having 8 cm X 10 cm graduations and appropriate color filter over face of tube. Scale illumination control varies level from zero to intensity adequate for photographic recording

Beam Finder

A momentary contact switch is provided to facilitate location of beam when it is positioned off screen

Upper & Lower Beam Z Axis (Optional Type 7088 Kit)

Negative pulse to grid of CRT blanks trace. 25 volts are required into a resistance of 1 megohm and coupled through a series 0.01 µf capacitor dims trace

VOLTAGE CALIBRATOR

Availability

0.2V and 2.0V peak-to-peak calibrator signals available at pin jack on front panel; fast rise and fall time permits adjustment of attenuator probe. Calibrator signal is applied to input of Y amplifier to aid in standardizing gain when the V/CM switch is set to CAL

Accuracy

Nominally ±1%, always with ±3%

Frequency

Locked to twice the power-line frequency

POWER REQUIREMENT

Line Voltage

115/230 volts ±10% at 60-cycle line

Line Frequency

Operation from 48 through 1000 cycles; line voltage excursion is reduced at extremes of frequency range and where power line distortion exceeds 5%

165 watts average; 180-volt amperes at 115-volt, 60-cycle line

SPECIFICATIONS (Concluded)

MECHANICAL DIMENSIONS

NOTE: This oscilloscope is constructed for universal bench or rack use.

	BENCH		*RACK		
Height (with feet)	7-5/8"	(19.4 cm)	6-31/32"	(17.7 cm)	
Width	16-3/4"	(42.5 cm)	19"	(48.3 cm)	
Depth (extension behind panel)	20-5/8"	(52.4 cm)	18-5/8"	(47.3 cm)	normal mounting
			17-5/8"	(44.8 cm)	brackets reversed
Weight	35 lbs	(15.9 kg)	35 lbs	(15.9 kg)	

*A minimum of 2" clearance must be maintained when rack-mounting to assure adequate cooling.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature Range

From 0°C to +40°C. All models incorporate a thermal cutout switch to protect the unit when cooling is insufficient. Adequate ventilation and clearance around unit must be provided in rack-mounted installation to assure intake air below the specified embient temperature

Storage Temperature Range

From -40°C to +85°C

Altitude Ranges

Sea level to 10,000 feet

SECTION 2

OPERATING INSTRUCTIONS

2-1. FIRST TIME OPERATION (Figures 2-1 to 2-8)

To place the instrument in operation, plug the power cord into the proper grounded power source and turn INTENSITY control counterclockwise. Rotate the SCALE ILLUM control clockwise to apply power. Allow approximately 15 minutes for the instrument to warm up. In the instructions which follow, the words in capital letters within the text indicate front-panel controls, connectors, or settings.

Numerous accessory components are available to extend the usefulness of these oscilloscopes. See Section 1 for a complete listing.

The following illustrations are designed to aid the operator in becoming familiar with the oscilloscope.

Figure	Type 708A Facilities
2-1	Cathode-ray Tube
2-2	Upper Beam
2-3	Trigger
2-4	Time Base
2-5	Horizontal Deflection
2-6	Lower Beam
2-7	Rear Panel
2-8	Initial Setup

We know that you are anxious to get acquainted with your new instrument. To aid you in this endeavor, you may set up the instrument using the built-in calibrator signal to demonstrate the effects of the various controls on the display. See Figure 2-8 for initial setup of controls.

2-2. VERNIER AND ATTENUATOR BALANCE ADJUSTMENT

When the VERN and ATTEN **BAL** controls are properly adjusted, there will be no depositioning of the trace when the SENSITIVITY and PULL VARIABLE controls are used. To adjust, proceed as follows:

1. Set the X DISPLAY switch in the SWEEP X1 NORM position.

2. **Pull out the Upper and Lower Beam PULL VARIABLE** controls and rotate them fully counterclockwise to their minimum gain setting and the SENSITIVITY controls to the 10 V/cm position.

3. Center the trace on screen using the POSITION controls.

   NOTE: It may be necessary to depress and hold the BEAM FINDER button and adjust the VERN BAL control to position the trace on screen.

4. Rotate the Upper Beam PULL VARIABLE clockwise to its maximum gain position observing the direction that the beam shifts vertically.

5. Adjust the front-panel VERN BAL control to bring the trace back to the center of the screen.

   NOTE: Do not change the setting of the POSITION controls.

6. Continue adjusting the front-panel VERN BAL control while rotating the Upper Beam PULL VARIABLE back and forth until there is no depositioning of the trace when the PULL VARIABLE control is rotated throughout its range.

7. Set the FINE ATTEN BAL control (outer knurled knob) to the center of its range.

8. Adjust the COARSE ATTEN BAL control (inner knurled knob) until there is no depositioning of the trace while switching the SENSITIVITY control back and forth between the 10 V/cm and the OFF positions.

   NOTE: The VERN and ATTEN BALance controls are interdependent and must be repeated several times for optimum balance adjustment.

9. Repeat these balance adjustments for the LOWER BEAM amplifier using pertinent controls, settings and adjustments.

2-3. THERMAL CUTOUT

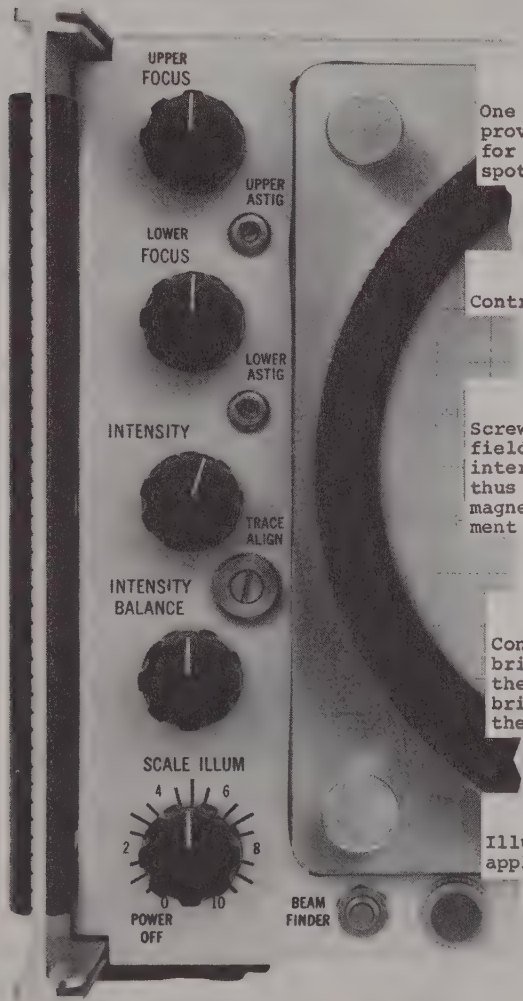
A thermal cutout switch is connected in series with one side of the power line of this instrument. When the interior temperature of the instrument exceeds the safety limit, the thermal cutout switch will trip removing power from the unit. It will reset itself when the interior temperature drops to a safe value. Possible causes of over heating are restriction of air circulation or high ambient temperature. Rack installation should be designed with a nominal clearance of 2 inches all around (1-1/2 inches minimum) and hot air must not be circulated through the oscilloscope.

2-4. PRECAUTION AGAINST SCREEN BURNING

A sharply focused spot of high intensity and small area should not be permitted to remain stationary on the screen for any length of time. Under such conditions, the entire beam energy is concentrated over a small area, thus subjecting the screen material to burning and discoloration. This condition is most likely to exist when using the unit for X-Y plotting with the INTENSITY control turned up, and with no signal to deflect the beam.

UPPER OR LOWER FOCUS

One of two identical controls: provides an adjustable voltage for cathode-ray tube focus grid to optimize spot size



UPPER OR LOWER ASTIG

One of two identical controls: provides an adjustable voltage for cathode-ray tube to optimize spot shape

INTENSITY

Control: varies trace brightness

TRACE ALIGN

Screwdriver control: varies the field strength which the CRT beam intercepts causing it to rotate, thus compensating for the earth's magnetic effect on trace alignment

INTENSITY BALANCE

Control: varies upper trace brightness when rotated to the left and the lower trace brightness when rotated to the right

PILOT LAMP

Illuminated lamp indicates application of primary power

SCALE ILLUM

Control with switch: dimmer control varies scale illumination; attached switch turns power on or off

BEAM FINDER

Momentary control switch: reduces amplifier output and scale down display permitting location of beam and centering with X & Y POSITION controls

FIGURE 2-1 TYPE 708A FRONT PANEL FACILITIES, CRT SYSTEM

UPPER BEAM SENSITIVITY, PULL VARIABLE

Concentric controls: Outer knob (black) provides a discrete, calibrated attenuator for Input signals with amplitude as indicated on the front panel (PULL VARIABLE in) CAL & OFF settings also provided; sensitivities above 100 uV/cm are automatically AC STABilized (green)

Inner knob (red) provides a 1:2-1/2 variable adjustment permitting minimum sensitivity overlap of the UPPER BEAM SENSITIVITY setting; push-pull switch assures calibrated amplifier setting

CAL 0.2V

Pin jack: enables calibration check of 10:1 probes at high-sensitivity amplifier setting when UPPER or LOWER BEAM SENSITIVITY switch is set to 5mV/cm (4 cm defl)

CAL 2V

Pin jack: enables calibration check of 10:1 probes at low-sensitivity amplifier setting when UPPER or LOWER BEAM SENSITIVITY switch is set to 50 mV/cm (4 cm defl)

CAL 4 cm

Screwdriver controls: sets gain of Upper Beam Amplifier at low sensitivity end (black) or high sensitivity end (green) for a specific deflection of 4 cm to insure accuracy of vertical amplitude measurements

ATTEN & VERN BAL

Controls: when properly adjusted prevents vertical depositioning of trace when UPPER BEAM SENSITIVITY and FULL VARIABLE controls are activated

BANDWIDTH SELECTOR

Switch: provides three selectable bandpasses as indicated on front panel to insure optimum performance at the higher amplifier sensitivities

INPUT SELECTOR, POSITION

Concentric controls: Outer knob (black) selects one of two individual channels for single-ended input or selects Channels A & B for differential input for Upper Beam Deflection Amplifier; choice of ac or dc coupling. Use AC STAB setting to minimize low-frequency drift

Inner knob (red) positions Upper Beam vertically

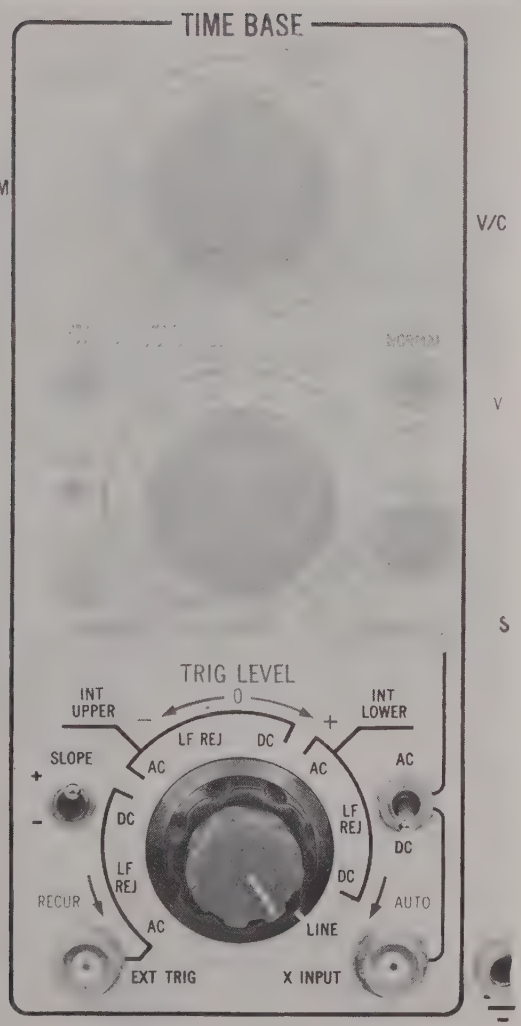
A & -B INPUT

BNC connectors: for applying external signals to the Upper Beam Deflection Amplifier via the Input Selector switch. Positive signals applied to INPUT A deflect the beam upward; connection to -B inverts the signal

DIFF BAL

Screwdriver control: adjusts for the maximum differential rejection ratio of the Upper Beam Amplifier

FIGURE 2-2. TYPE 708A FRONT PANEL FACILITIES, UPPER BEAM SYSTEM



SLOPE

Toggle switch: enables choice of slope polarities as indicated

TRIG SELECTOR & TRIG LEVEL

Concentric controls: Outer knob (black) enables trigger selection from external source, internal upper or lower amplifier source and with choice of direct or capacitive coupling; LINE triggering also provided

Inner knob (red) TRIG LEVEL control with switches selects trigger signal voltage at which the sweep is fired; switch actuation permits AUTOmatic triggering (fully cw) and RECUR sweep (fully cw)

EXT TRIG

BNC connector: for applying external triggering signals through EXT TRIG position of trigger Selector switch

FIGURE 2-3. TYPE 708A FRONT PANEL FACILITIES, TRIGGER SYSTEM

TIME/CM & PULL VARIABLE

Concentric controls: Outer knob (black) selects discrete, calibrated sweep rates as indicated on front panel (PULL VARIABLE in)

Inner knob (red) provides a continuous, uncalibrated range of sweep rates within the limits established by the Time/cm setting; push-pull switch assures calibrated sweep rates

NORMAL/SINGLE

Toggle switch: permits NORMAL or SINGLE sweep operation

SWP CAL

Screwdriver control: provided to standardize accurately the Time/cm switch settings

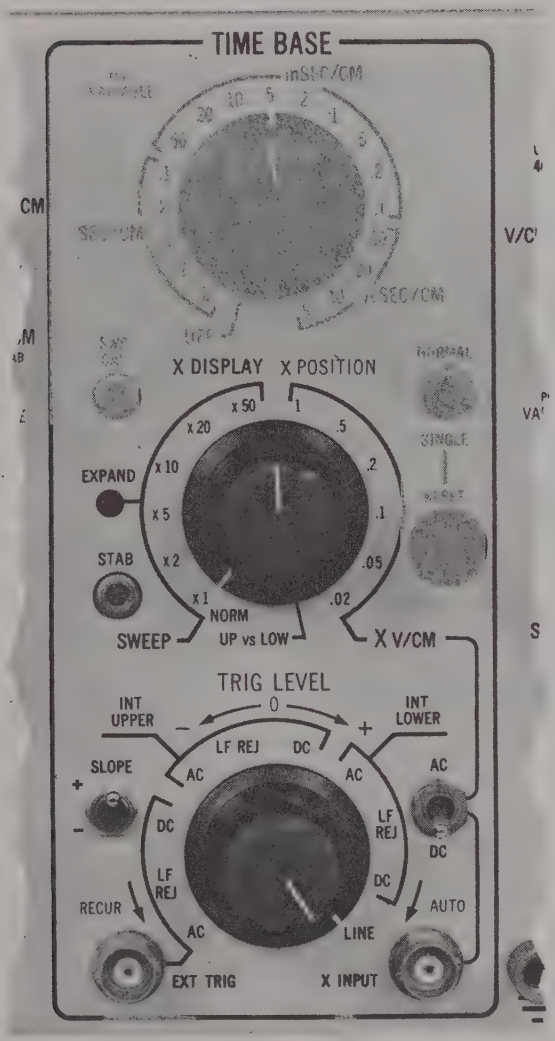
STAB

Screwdriver control: enables proper adjustment of recurrent sweep mode when TRIG LEVEL control is set to RECUR

RESET

Permits rearming of SINGLE sweep via contact to ground by either manual operation of RESET push button switch or by remote control operation of EXT RESET connector located on rear panel. RESET lamp lights each time bottom is depressed in the SINGLE sweep mode

FIGURE 2-4. TYPE 708A FRONT PANEL FACILITIES, TIME BASE SYSTEM



Concentric controls: Outer knob (black) the EXPAND sector provides discrete expansion of the internal sweep by factors from 1 to 50; provides a discrete calibrated attenuator for X INPUT signals as indicated within the X VOLTS/CM sector. UP vs LOW positions provided for X-Y plotting

Inner knob (red) positions trace horizontally

EXPAND

Indicator Lamp: lamp is lit whenever the X DISPLAY switch is set up for expanding the internal sweep by factors of 2 to 50. Lamp is not lit in X1 position of the sweep EXPAND DISPLAY

AC/DC

Toggle switch: provides choice of AC or DC coupling of X INPUT signals

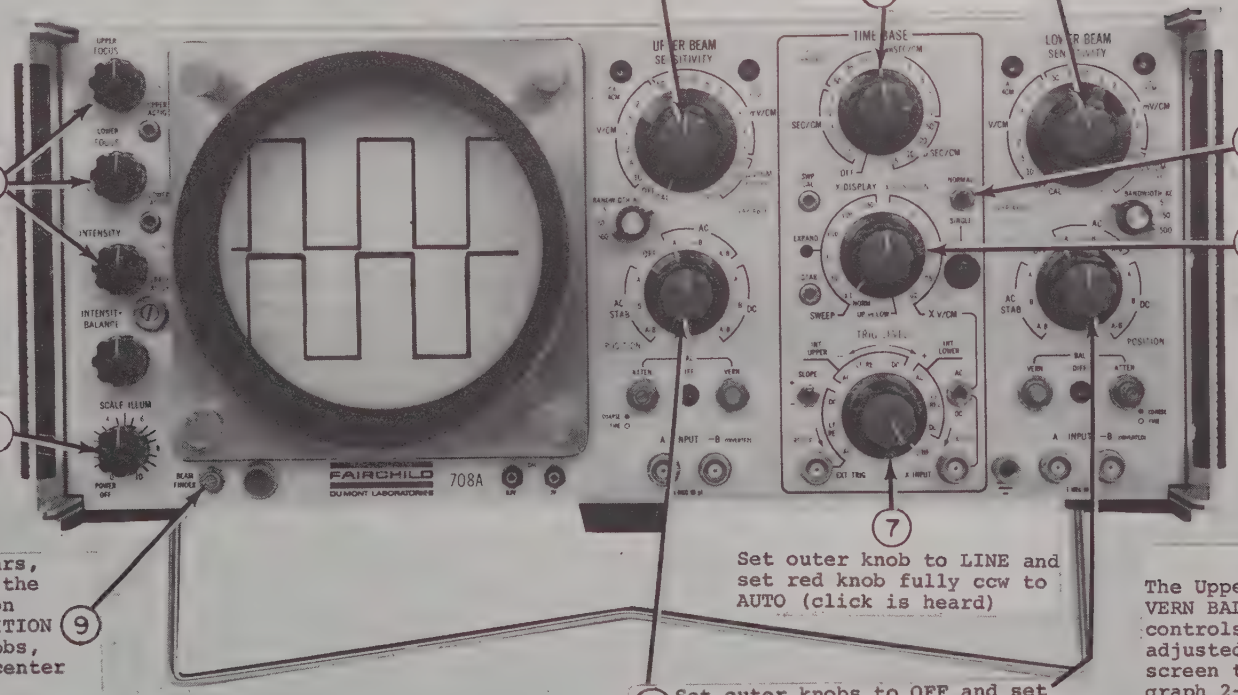
X INPUT

BNC connector: for applying external signals to the horizontal deflection amplifier when X DISPLAY switch is set to one of the X V/CM positions

FIGURE 2-5. TYPE 708A FRONT PANEL FACILITIES, HORIZONTAL DEFLECTION SYSTEM

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.



(3) Push in red knobs and set outer knobs fully ccw to CAL (Black)

Push in red knob and set outer knob to 2 msec/cm (4)

Set UPPER FOCUS, LOWER FOCUS and INTENSITY controls to center of range (2)

(5) Set toggle switch to NORMAL

(6) Set outer knob to X1 NORM SWEEP and set red knob to center of range

Rotate clockwise to turn on the oscilloscope (1)

(7) Set outer knob to LINE and set red knob fully ccw to AUTO (click is heard)

If no trace appears, depress and hold the BEAM FINDER button and readjust POSITION controls (red knobs, see (6) and (8) to center the display (9)

(8) Set outer knobs to OFF and set red knobs to center of range

Readjust INTENSITY & FOCUS controls see (2) for a sharp pattern (10)

Note: To obtain a display when external signals are applied, do not set outer knobs to OFF

NOTE

The Upper and Lower Beam VERN BAL and ATTEN BAL controls must be properly adjusted to obtain an on-screen trace. See paragraph 2-2

FIGURE 2-8 INITIAL SETUP OF TYPE 708A OSCILLOSCOPE

2-5. ILLUMINATED SCALE

The adjustable scale lighting control labeled SCALE ILLUM may be adjusted to suit the lighting conditions of the room or the f/number on the oscilloscope camera.

The scale is accurately scribed in centimeters. An illuminated internal anti-parallax graticule is optionally available. No special techniques or equipment are required to photo-record from the Fairchild Internal Anti-parallax Graticule.

2-6. NORMALIZING UPPER & LOWER BEAM AMPLIFIERS

The CAL 4CM front-panel screwdriver controls are provided to set up the beam amplifier for a specific deflection to insure accuracy of vertical amplitude measurement. The CAL 4CM adjustments are color matched and should be used with the associated color sector of the SENSITIVITY switch. To properly normalize the gain of the instrument, proceed as follows:

1. Set up the oscilloscope as indicated in Figure 2-8.

2. Set the UPPER BEAM SENSITIVITY switch fully counterclockwise to CAL (black) and make sure the PULL VARIABLE knob is pushed in.

3. Set the BANDWIDTH KC selector switch to 5.

4. Adjust the CAL 4CM (black) screwdriver control for 4 centimeters of vertical deflection.

5. Rotate the UPPER BEAM SENSITIVITY switch fully clockwise to CAL (green).

6. Adjust the CAL 4CM (green) screwdriver control for 4 centimeters of vertical deflection.

7. Repeat steps 2 through 6 for the Lower Beam Amplifier using pertinent controls, settings, and adjustments.

2-7. Y INPUT SELECTOR SWITCHES

a. SWITCH SELECTION

Starting from the fully CCW position, the X and Y Input Selector switches provide the following selections:

1. AC STAB coupled differential (balanced) input using INPUT A and INPUT-B connectors.

2. AC STAB coupled signal through INPUT-B connector, inverted polarity.

3. AC STAB coupled signal through INPUT A connector, normal polarity.

4. An OFF position is provided which disconnects the Y Input terminals and grounds the input of the Y amplifier.

5. AC coupled signal through INPUT A connector, normal polarity.

6. AC coupled signal through INPUT-B connector, inverted polarity.

7. AC coupled differential (balanced) input using INPUT A and INPUT -B connectors.

8. DC coupled signal through INPUT A connector, normal polarity.

9. DC coupled signal through INPUT-B connector, inverted polarity.

10. DC coupled differential (balanced) input using INPUT A and INPUT-B connectors.

b. AC STAB COUPLING

When the AC STAB sector of the Input Selector switch is in use, low-frequency drift is eliminated in the input section of the amplifier by AC coupling at a point beyond where there is negligible drift. Sensitivities above 100 uV/CM are automatically AC STABilized (green sector). When working in the AC STAB mode, the VERN & ATTEN BAL adjustments should be checked at regular intervals. Optimum stability is reached after thermal equilibrium is reached throughout the oscilloscope. (See Specifications in Section 1 for nominal low-frequency cutoff data.)

c. AC OR DC COUPLING

The AC/DC position of the Input Selector switches permits choice of retaining the dc level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input. If it is desired to display both the ac and dc components of a signal, set the Input Selector switch to the DC sector. Thus, the position of the display at any instant is a function of the instantaneous signal voltage with respect to ground.

There are times when it is neither necessary nor desirable to display the dc component of the input waveform. A capacitor placed in series with the input connector will exclude the dc component while simultaneously permitting the ac component to be displayed. This is accomplished when the Input Selector switch is set to the AC sector. In this instance, the effect of the dc component is now excluded from the display.

d. DIFFERENTIAL INPUT FEATURES (Figure 2-9)

For differential input, set the Input Selector switch to A-B position, and one of the following sectors: AC STAB, AC, or DC.

One of the salient features of the two terminal balanced-to-ground input circuit is the behavior of the differential amplifier. This circuit makes it possible to reject to a considerable degree any common-mode signal, while at the same time passing and amplifying the differential input signal. Thus, if there is any balanced-to-ground pickup of noise on test leads or in the equipment under test, such noise will be reduced materially on passing through the differential amplifier circuit.

2-8. OBTAINING A DISPLAY

To use the Type 708A Oscilloscope to obtain a display, proceed as follows:

1. Signals to be observed are connected to the oscilloscope through connector INPUT A and/or INPUT-B via shielded cable or an Attenuator Probe.

2. Establish a common ground between the oscilloscope chassis and the signal source.

3. The Input Selector switch permits choice of input connector, polarity, and capacitive or direct coupling of the signal to the compensated attenuator.

4. Adjust the appropriate Time Base controls to obtain a stable display of the pattern. Use of the Auto trigger mode may be desirable in setting up the display.

5. Set the Upper & Lower Beam SENSITIVITY switches and POSITION controls such that the size and position of the display is as desired on the screen. If necessary, use the BEAM FINDER push button to speedily locate the display.

In addition to the preceding 5 steps, observe the following precautions when applying signals to the oscilloscope:

1. Avoid errors in readings due to stray coupling between circuits, particularly in the signal lead. As a rule, do not use long unshielded leads for applying signals to the oscilloscope. This fact holds for the audio-frequency spectrum, except possibly when making measurements on low impedance circuits at very low frequencies. Coaxial or shielded input cables are recommended for most applications.

2. In broadband applications, it may be necessary to terminate a coaxial cable with a resistance equal to its characteristic impedance. This is done to prevent standing waves or ringing (high-frequency damped oscillations).

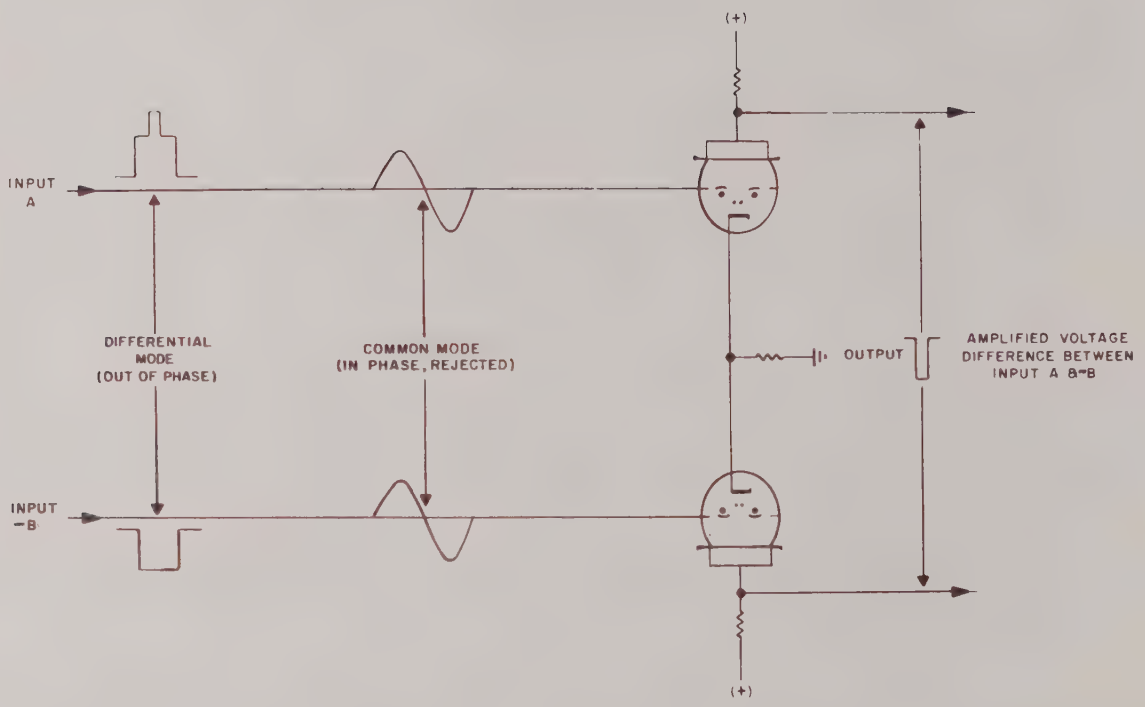


FIGURE 2-9. ILLUSTRATING DIFFERENTIAL OPERATION

3. To avoid erroneous results, the operator should simulate the actual operating conditions of the equipment being tested. For example, the equipment should work into a load impedance equal to that which it will see in actual use.

4. Consider the effect of loading upon the signal source due to the input impedance of the oscilloscope. The input impedance can be represented by a resistance shunted by a capacitance. The effective value of this impedance is indicated in the Specifications. However, the operator should be aware that even with a few feet of cable in the input circuit; the loading capacitance on the circuit under investigation might be greater than 100 pf.

5. There are cases when connecting the input of the oscilloscope to a signal source, the effect of loading the source is not negligible. To minimize this loading and therefore obtain a valid measurement, a probe may be used in the manner described in the paragraph entitled "Use of Probes."

6. Care must be exercised when applying a fast rise, high-frequency signal to the input connector. It will be necessary to match and properly terminate the coaxial cable applying the signal to the oscilloscope.

7. As the length of the cable is increased, the necessity for proper termination becomes very important. This termination is generally inserted at the oscilloscope end of the cable, although many signal sources may require an additional termination at the other end of the cable. The Type 4285A Termination is recommended for 50-ohm systems.

For rack-mounting systems, observe the following precautions if long shielded cables are used.

1. It may be desirable to ground long shielded leads only at one end to avoid circulation currents. Even micro-amperes of extraneous currents in the shielded braid will cause unwanted distortions.

2. Use cable with insulation over the shielded braid so that the cable does not accidentally touch ground.

3. Use off-ground insulated bulkhead feed-thru connectors where applicable.

4. Do not pass cables near strong ac magnetic fields.

5. Long shielded input cables may also induce parasitic oscillations. It is suggested that a 100-ohm to 1000-ohm, 1/2-watt resistor be connected in series with the center conductor near or at the oscilloscope input terminals.

6. Use a resistance at least twice that required to just stop the parasitic oscillations. Too large a value may reduce the bandwidth of the system.

2-9. USE OF PROBES

An attenuator probe reduces both the capacitive and resistive loading caused by the oscilloscope. Simultaneously, while isolating the oscilloscope from the signal source, it reduces the effective sensitivity of the instrument. In other words, the displayed waveform will be reduced in amplitude by the attenuation factor of the probe.

When using the probe to sample signals from a tuned, matched, or otherwise critical circuit, capacitive loads may cause erroneous readings. In these cases it may be necessary to remove capacity and resistance from the circuit under observation. When the observations and adjustments are completed, capacitance and resistance precisely equal to that of the probe impedance, should be added to the circuit after the probe is removed from the circuit. This substitution will equalize loading and restore the operating characteristics of the circuit under observation to the same conditions as when probe measurements were made.

When using the attenuator probe to make amplitude measurements, multiply the observed amplitude of the display by the attenuation factor marked on the probe.

The Accessory Probes listed in Section 1 of this manual have an attenuation factor of 10 to 1. The maximum voltage that may be applied to these probes is 600 volts dc plus peak ac. Voltages in excess of this value (either dc volts or peak ac volts) may cause damage to components inside of the probe housing.

IMPORTANT: Before using the probe, always check its adjustment.

An adjustable capacitor in the probe compensates for variations in input capacitances from one unit to another. To insure accuracy in pulse and transient measurements, check the probe adjustment frequently.

2-10. SWEEP TRIGGERING

To obtain a stable display, the sweep must consistently start at the same time relative to recurring cycles of the input waveform. If the sweep is allowed to occur at random at a rate unrelated to the occurrence of the input waveform, the displayed pattern will be traced out at a different point on the screen each time the sweep runs. This will either cause the waveform to drift across the screen or to be unintelligible. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. For present purposes, the starting of each horizontal wave across the screen may be called "triggering the sweep." The following instructions tell you how to select and use the proper triggering signal for various applications.

2-11. TRIGGER SOURCE SELECTION

a. INTERNAL

For most applications, the sweep may be triggered by the Y input signal. The only requirement is that the signal amplitude be sufficient to trigger the sweep. To obtain triggering of the sweep from the input signal, set the Trigger Selector switch to the INT UPPER or LOWER sector. Internal triggering is convenient since no external triggering connections are required. Satisfactory results are obtained in most applications.

b. EXTERNAL

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within an instrument. With external triggering, the triggering signal usually remains constant in amplitude and shape. Thus, it is possible to observe the shaping and amplification of a signal in an external circuit without resetting the oscilloscope triggering controls for each observation. Also, time and phase relationships between the waveforms at different points in the circuit can be seen. For example, if the external triggering signal is derived from the waveform at the input to a circuit, the time relationship and phase of the waveforms at each point in the circuit are compared to the input signal by the displayed waveform.

When a stable, external triggering signal is available, it is possible to observe and accurately measure jitter of the displayed waveform with respect to the trigger input signal. This is not possible when the sweep is triggered internally. Internal triggering will not permit base line to show on screen prior to the rise of the signal being observed. A trigger preceding the signal may be used to externally trigger the oscilloscope to display the entire signal.

To obtain a stable display, the external triggering signal must have an amplitude of at least 0.5 volt, peak-to-peak, and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the EXT TRIG connector and set the Trigger Selector switch to the External Trigger.

c. LINE

If the pattern on display bears a fixed time relationship to the power-line frequency, the sweep may be triggered by this signal. To accomplish this, set the Trigger Selector switch to LINE.

2-12. TRIGGER COUPLING SELECTION

a. AC COUPLING

Selection of the AC triggering mode is accomplished by setting the Trigger Selector switch to the desired AC sector. This mode is provided with a high-pass filter that has a low-frequency cutoff nominally at 80 cycles. This feature prevents erratic triggering when positioning the pattern vertically while using internal triggering. In the AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display via use of the TRIG LEVEL control.

When using the AC mode, the trace always starts at the same point on the Waveform for a given TRIG LEVEL control setting regardless of the vertical positioning.

b. DC COUPLING

The DC mode is especially useful for viewing waveforms which change very slowly and which are therefore discriminated against by the low-frequency cutoff of the AC position (80 cps). Because of the coupling network time constant in the AC mode, signals having random repetition rates are sometimes viewed more stably in the DC mode.

This mode permits excellent triggering on all types of waveforms and is most useful in the following applications:

1. For optimizing trigger sensitivity or operation when very low frequencies are applied;

2. For maintaining the initial reference position of the trace with respect to the CRT scale at a given TRIG LEVEL control setting when on Internal source; and

3. For avoiding trigger point variations due to random repetition rate triggering signals.

When using the DC mode, the trace always starts at the same point on the Scale for a given setting of the TRIG LEVEL control regardless of the vertical positioning.

c. LF REJECT COUPLING

The LF REJECT mode is a special high-frequency form of the AC mode and is used to reject low-frequency components such as 60-cycle hum in the triggering signal. Use AC triggering unless low-frequency rejection is required. Triggering signals with frequency components below 15 Kc, for example the calibrator signal, will not initiate the sweep circuits when the LF REJECT mode is used. To insure stability, the triggering signal should rise in less than 100 μsec.

Occasionally it is required to obtain stable triggering from a complex high-frequency waveform that contains undesirable low-frequency noise or line-frequency components. In such cases, the additional noise and line pickup may make it difficult to obtain a stable display. If this occurs, select the LF REJECT triggering mode, thereby eliminating the effects of these undesired components. The low-frequency components are blocked from the triggering circuit while the high-frequency triggering waveform is passed to produce the stable triggering that is required. In all other respects, the LF REJECT triggering mode is identical to the AC mode.

2-13. TRIGGER SLOPE SELECTION

When the Trigger SLOPE switch is set to +, the sweep is triggered on the rising or positive slope of the excitation signal. When the Trigger SLOPE switch is set to -, the sweep is triggered on the falling or negative slope of the excitation signal.

2-14. TRIGGER LEVEL SELECTION

The TRIG LEVEL control permits selection of a specific voltage which the triggering signal must exceed before the sweep fires. When the Trigger SLOPE switch is set to the + position, adjustment of the TRIG LEVEL control makes it possible to trigger the sweep consistently on the positive slope of the excitation signal. Conversely, with the Trigger SLOPE switch set to the - position, adjustment of the TRIG LEVEL control makes it possible to trigger the sweep consistently on the negative slope of the excitation signal.

2-15. SWEEP OPERATIONAL MODES

a. INTRODUCTION

When the NORMAL/SINGLE switch is set to NORMAL, the oscilloscope may be set up for triggered or automatic sweep. In the SINGLE mode, the time base moves but one stroke until reset.

b. AUTOMATIC SWEEP

When using the AUTO mode, a horizontal reference trace will appear on the screen even in the absence of an input signal. This AUTOmatic mode is very useful while testing equipment since a reference trace will always be visible regardless of whether a signal is applied to the oscilloscope or not.

The AUTO mode simplifies synchronization of signals or periodic waveforms having repetition rates greater than 50 cycles.

To obtain AUTOmatic sweep operation, set the TRIG LEVEL control fully clockwise to AUTO (switch is actuated) and the NORMAL/SINGLE switch to NORMAL.

c. TRIGGERED SWEEP

A stable pattern for practically all types of signals can be obtained by using triggered sweep. Its use is mandatory for viewing random or non-periodic signals having low repetition rates. Use of the triggered sweep mode of operation in the majority of applications is the preferred condition under which optimum triggering performance can be expected of this instrument.

When the oscilloscope is set for triggered sweep, the spot will be visible only during forward sweep time. The INTENSITY control must be properly adjusted to make the sweep visible. For triggered sweep operation, proceed as follows:

1. Apply the desired signal to INPUT A and set front-panel controls as previously indicated in Figure 2-8.

2. Adjust PULL VARIABLE control in conjunction with the SENSITIVITY switch to obtain a vertical deflection of approximately 4 centimeters.

3. Adjust TRIG LEVEL control to initiate the sweep and the POSITION controls to center the display.

4. Rotate the TIME/CM and PULL VARIABLE controls to obtain the desired display. Readjust the TRIG LEVEL control if necessary.

5. Adjust INTENSITY and FOCUS controls to obtain a sharp trace of suitable brightness.

6. If there is any multiple triggering of the sweep, the TRIG LEVEL control may be adjusted to select the signal levels which will best actuate the trigger circuit. Thus, undesirable signals of lesser amplitude will be rejected by the trigger channel.

7. Set Trigger Selector switch to the desired LF REJECT sector to obtain a more stable display when using a high-frequency triggering signal.

d. SINGLE-SWEEP OPERATION

Single-sweep operation infers that the time base moves but one stroke until reset. Using a repetitive sweep to view a varying waveform would result in an overlapped and unintelligible display caused by many cycles of the single trace being superimposed on one another. However, when it is desired to view a single display of an input signal which continually varies in amplitude, shape, or time, the NORMAL/SINGLE switch should be set to SINGLE for single-sweep presentation. Thus, by commanding but one stroke of the sweep at a time, the SINGLE position eliminates the overlapping caused by the multiple traces and enables the display to be viewed and/or recorded clearly. Reset may be accomplished manually, or through external contact closure.

1. Manual Reset

To arm the sweep manually, set the NORMAL/SINGLE switch to SINGLE and depress the RESET button. The sweep will remain armed until a trigger signal arrives to fire the sweep. One sweep will occur after which further incoming triggers are locked out until the circuit is rearmed. In other words, a single trace will sweep across the screen each time the sweep is triggered and at the end of its travel, the beam will rest off screen. The SWEEP RESET lamp should now be off thus indicating that the sweep requires rearming (resetting).

To rearm the sweep, push in the RESET button. The Sweep set indicator lamp will go on, indicating the sweep is armed and ready to fire on the next trigger.

2. Remote Reset By Synchro Shutter Contact Closure

The sweep may be armed remotely by means of a contact closure introduced through the two-contact EXT RESET connector located on the rear panel. This contact closure may be supplied by an Oscilloscope-Recording Camera such as the Type 450A.

The Type 4570B Cable Assembly, available as an accessory, is provided to connect the Fairchild Type 450A Camera to the rearming connector (EXT RESET) of the oscilloscope.

Multiple strokes of the oscilloscope display may integrate the light output sufficiently to improperly expose the fil

The recording system may now be arranged to permit but one single shot of the oscilloscope display to be seen by the film. Consequently, application of the single-sweep technique will eliminate multiple stroke light integration on film and phosphor.

If the synchro-shutter contact closure is provided by the Type 450A Camera at the instant the shutter is fully open, the lens need only be left open for a period exceeding the maximum time between sweep trigger pulses plus the total sweep time. The sum should be multiplied by a factor of 1.5 (to compensate for camera shutter speed and system variations) to assure optimum recording ease. A single setting of the illuminated graticule, trace brightness, the sweep rate then permits minimum camera exposure and oscilloscope intensity adjustments.

In applications where only a single event occurs and must be recorded to avoid duplication of the test, the above system is also applicable. Many systems require the simultaneous recording of a group of phenomena by several oscilloscopes equipped with cameras. If these cameras are to be triggered by electrically activated solenoids, the time delay differential of solenoids and shutter actuation would present a difficult problem. Nevertheless, all shutter actuation time delays may be negated when the synchro switch in the Type 450A Camera lens is permitted to arm all of the oscilloscopes in the system and ready them for simultaneous single-shot record-ing.

It is suggested that you consult your Oscilloscope Camera Instruction Manual or your local Fairchild Applications engineer for specific details.

2-16. SWEEP EXPANDER

When the X DISPLAY Selector switch is set to SWEEP, the sweep may be expanded about the center of the screen from 1 to 50 times. The EXPAND sector of the X DISPLAY switch provides horizontal magnification of the internal sweep by factors of 1, 2, 5, 10, 20 and 50. Thus, the fastest sweep rate is extended to 100 nanoseconds/cm. Any portion of the expanded display may be observed by adjusting the POSITION control.

When the instrument is set up for sweep expansion, the sweep rate indicated by the setting of the TIME/CM sector) to obtain the actual time required for the spot to move one centimeter. The expanded sweep rate may be expressed as follows:

$$\text{Expanded Sweep Time/Cm} = \frac{\text{TIME/CM setting}}{\text{EXPAND setting}}$$

For example, if the TIME/CM control is set to 5 mSEC, and the EXPAND sector of the X DISPLAY switch is set to X5, the actual time per centimeter is 5 milliseconds, divided by 5, or 1 millisecond per centimeter.

Or using the formula: $\frac{5 \text{ msec/cm}}{5} = 1 \text{ msec/cm}$

2-17. X-Y DISPLAYS AND ELECTRONIC SHUTTER (Figure 2-10)

a. INTRODUCTION

Turn X DISPLAY Selector Switch to up Vs low. When desiring to view one voltage plotted against another (not the internal time base), simply connect the signals to the amplifier input terminals and adjust the oscilloscope controls to obtain an appropriate display on the cathode-ray tube screen. It will be necessary to set the TIME/CM switch to OFF to obtain "steady" intensity. Note that screen damage can result from too intense a beam resting at one point on the screen.

X-Y plots obrained from transducers on rotating machinery, or other sources supplying a family of curves, may be difficult to interpret. The TIME/CM switch should then be used as an "electronic shutter" timing selector which will brighten the display for a period of nominally 10.5 times the sweep rate indicated.

The starting point of the illuminated or "strobed" section of the X-Y display may be adjusted with the TRIG LEVEL control. AC or DC coupled triggering from Y Channel internal, line frequency, or an external source related to the device under test, may be selected with the Trigger Selector switch.

b. PHOTO-RECORDING APPLICATIONS

When the oscilloscope is used to record X-Y displays (without use of the internal time base), the saw generator remains inoperative. If it is triggered from an external source, a normal unblanking gate pulse will be produced. To use this unblanking gate pulse for controlling a photographic exposure (an electronic shutter) proceed as follows:

1. Set the sweep range and vernier controls equal to the desired exposure time.

2. Set NORMAL/SINGLE switch to SINGLE.

3. Open the camera shutter on "Bulb" or "Time" and apply the sweep trigger pulse or fire the sweep manually as indicated in a previous paragraph entitled "Single-Sweep Operation."

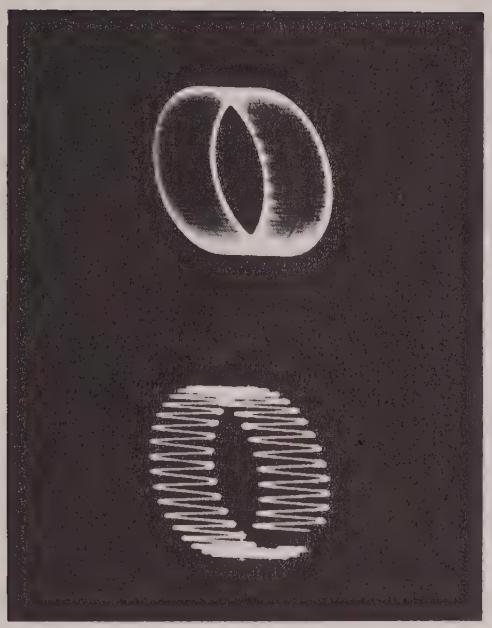
4. Close the camera shutter.

Figure 2-10 shows a drifting Lissajous pattern of two sine waves having slightly different frequencies. The upper pattern has the CRT beam on continuously while the lower pattern has controlled exposure brightening.

This is an extremely useful technique for recording the output of one transducer versus another, particularly when the phenomenon is non-cyclical. For example, the strain at one point in a mechanical system may be plotted against the velocity, acceleration, or displacement of some member of the prime mover of the system. Wherever the phase of the Y signal, is changing relative to the phase of the X signal, this electronically controlled exposure technique is useful.

The start of the exposure can sometimes be controlled by one of the two signals being displayed. For example, the sweep controls can be set so that when the Y signal reaches a set amplitude, the unblanking pulse will occur. Or, one may wish to start the exposure when the X or Y signal reaches its maximum rate of change. In this case the signal can be differentiated and the differentiated signal used to initiate the sweep trigger (through the external input circuit).

Finally, the intensity modulation input of the oscilloscope (Z input) can, also be used for controlled exposure brightening (or blanking) of varying or drifting patterns. In this case the exposure control pulse must be taken from an external source, such as a pulse generator.



Upper Pattern: Blurred because varying phase causes drift.

Lower Pattern: Same pattern photographed using electronic exposure brightening.

FIGURE 2-10. LISSAJOUS PATTERN RECORDED WITH AND WITHOUT CONTROLLED EXPOSURE BRIGHTENING

In using any form of electronically controlled blanking or trace brightening, it should be remembered that the camera mechanical shutter must be fully opened before triggering the sweep on the external pulse to the Z-axis of the CRT. The most common method of taking a photograph with electronic trace brightening is to use "Bulb" or "Time" exposure as previously mentioned.

If the oscilloscope camera shutter has "synchro" contacts, these contacts may be used to initiate the trace brightening or to arm the oscilloscope sweep circuit. Thus, one may set the camera shutter to some "instantaneous" value from 1 second to 1/100 second and use the shutter contacts to initiate the actual electronically controlled exposure.

Complete instructions and applications for rearming the oscilloscope sweep from the synchro shutter contacts will be found in the appropriate Fairchild Camera Instruction Manual.

2-18. INTENSITY (Z AXIS) MODULATION

Two BNC connectors are provided on the rear of the oscilloscope for Z Axis modulation. Negative pulses to the grids of the cathode-ray tube will blank the trace. Pulse amplitude of more than 25 volts is required into an impedance of approximately 500K ohms coupled via a 0.01 microfarad capacitor to dim the trace.

2-19. VOLTAGE MEASUREMENTS

a. GENERAL

The Type 708A Oscilloscope may be used to measure the voltage of the input signal by using the calibrated Upper or Lower Beam VOLTS/CM setting and observing the height of the display on the screen in graticule centimeters.

When making voltage measurements, use full scale vertical deflection to insure maximum accuracy. Also it is important to remember that the width of the trace may be an appreciable part of the over-all measurement.

This is particularly true when you are measuring signals of small amplitude or when stray signal pickup has broadened the trace. The operator should consistently make all measurements from one side of the trace. If the top side of the trace is used for one reading, it should be used for all subsequent readings.

NOTE: When making voltage measurements, make sure there is a common ground between the oscilloscope and the signal source.

b. MEASURING PEAK-TO-PEAK VOLTAGES (Figure 2-11)

The procedure employed for all voltage measurements is basically the same. The PULL VARIABLE control must be set to CAL. The specific examples that follow are intended to show the general procedure. These examples may be adapted to fit any particular application.

To measure the AC component of the signal on display, set the Input Selector switch to AC. In this position, only the AC components of the input signal are displayed on the screen. However, when the AC components of the input is of very low frequency, set the Input Selector switch to DC to prevent errors.

To make measurements, proceed as follows:

1. Using the calibrated scale, measure the vertical deflection in centimeters from the positive peak to the negative peak of the waveform.

2. Multiply the vertical dimension obtained in step 1 by the VOLTS/CM switch setting to obtain the indicated voltage.

3. Multiply the indicated voltage obtained in step 2 by the attenuation factor of the probe, if one is used, to obtain the actual peak-to-peak voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/CM switch is set to 0.1. Assume that the vertical distance between the peaks of the waveform measures 4 centimeters. Now, this dimension of 4 centimeters is multiplied by the VOLTS/CM setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, if a 10:1 Attenuator Probe is used. This gives 4 volts as the peak-to-peak voltage of the display waveform.

NOTE: Always make sure that the PULL VARIABLE control is pushed in when making measurements.

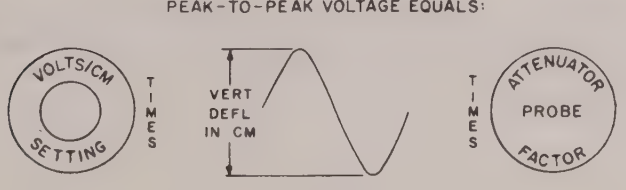


FIGURE 2-11. PEAK-TO-PEAK VOLTAGE MEASUREMENTS

c. MEASURING INSTANTANEOUS VOLTAGES WITH RESPECT TO A REFERENCE POTENTIAL (Figure 2-12)

The technique used for measuring instantaneous voltages with respect to a reference point, is virtually the same as that described for peak-to-peak voltage measurements. The difference is that now a reference point must be established on the screen of the oscilloscope. Since voltage measurements with respect to ground are the most common, the procedure which follows, establishes ground as the reference point. The same general technique may be used for instantaneous measurements with respect to any other potential, just so long as that potential is employed to establish the reference point.

To make measurements, proceed as follows:

1. Set the Input Selector switch to DC.

2. Adjust the appropriate Time Base controls for automatic sweep to obtain a reference trace.

3. To establish the reference point, touch the probe tip to the ground terminal on the oscilloscope (or to the desired source potential, if a point other than ground is used). Vertically position the trace to a convenient point on the screen. This point should be chosen so that it lies on one of the major horizontal scale divisions. The chosen horizontal scale line, which is now coincident with the trace, is the reference line from which all voltage measurements are to be made.

4. Disconnect the probe tip from ground and connect it to the signal source without disturbing the POSITION control.

5. Adjust the oscilloscope controls for a suitable and stable display.

6. Using the calibrated scale, measure the number of centimeters from the desired point on the waveform to the pre-established reference line set up in step 3.

7. Multiply the dimension obtained in step 6 by the VOLTS/CM switch setting to obtain the indicated voltage. Make sure that the VARIABLE control is in its CAL (pushed-in) position.

8. Multiply the indicated voltage obtained in step 7 by the attenuation factor of the probe used to obtain the actual instantaneous voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/CM switch is set to 0.1. Assume that the vertical distance between the desired point on the waveform to the pre-established reference line is 4 centimeters. Now, multiply this vertical deflection of 4 centimeters by the VOLTS/CM setting of 0.1 to give 0.4 volts. Next, multiply this result by 10, the attenuation factor of the probe. This shows that the instantaneous voltage with respect to ground to be 4 volts. Since the voltage point is above the reference line, the indicated polarity is positive.

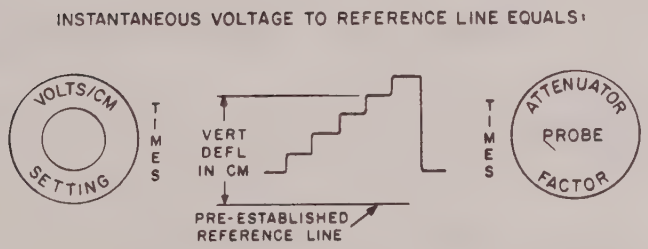


FIGURE 2-12. INSTANTANEOUS VOLTAGE MEASUREMENT WITH RESPECT TO A REFERENCE POTENTIAL

2-20. RISE-TIME MEASUREMENTS (Figure 2-13 and 2-14)

The response of an amplifier or other electronic device to a step function input signal is a measure of the ability of the device to pass signals without distortion. In general, the response of the device can be measured by comparing the rise time of the output signal with the rise time of the input signal. In the ideal case, the signal would be passed with zero change of rise time, indicating all signals would be passed without distortion. Further, if two devices yield identical rise times for the same step function input, they can be expected to provide similar responses to all types of waveforms.

The rise time is defined as the time between 10% and 90% of the amplitude.

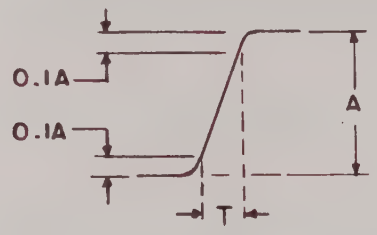


FIGURE 2-13. RISE TIME SKETCH

The rise time of the circuit is expressed in the form:

$$t_p = \sqrt{(t_o)^2 - t_a)^2}$$

Where: t_p = actual pulse rise time

t_o = observed rise time of pulse displayed on oscilloscope

t_a = amplifier rise time

Once the amplifier rise time is known (see Specifications) the rise time of any pulse may be calculated.

To make rise time measurements, proceed as follows:

1. Adjust pattern for full scale (10 cm) of vertical deflection.

2. Using the X and Y POSITION controls, adjust the display vertically so that the start of the waveform rests 1 centimeter below the scale horizontal center line and the rising portion of the waveform intersects the zero point on the scale (labeled A in Figure 2-14). Observe that the top of the waveform is off screen. Be careful not to accidentally change the setting of the X POSITION control.

3. With the Y POSITION control, move the waveform down until the top portion of the waveform rests 1 centimeter above the horizontal center line.

4. Note where the rising portion of the waveform intersects the X axis (labeled B in Figure 2-14).

5. Measure the distance between points A and B; multiply this reading by the TIME/CM switch setting to obtain rise time.

6. For example, if the distance between points A and B is 3 centimeters and the TIME/CM switch is set to 5 µs, the rise time would be 15 µs.

7. Rise time measurements made in this manner eliminate errors which would result from improper deflection plate alignment and incorrect interpolation.

8. Rise time of the amplifier may be checked by applying a pulse with an input rise 5 or more times faster than the amplifier.

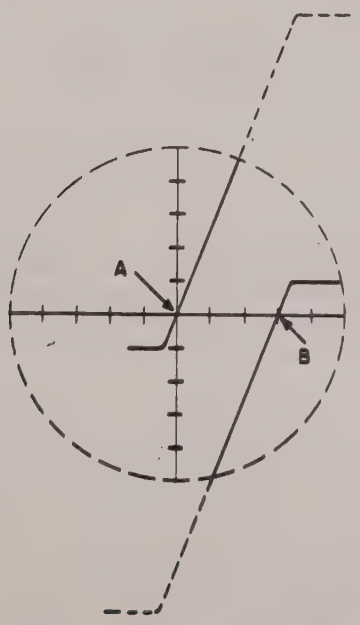


FIGURE 2-14. RISE TIME MEASUREMENT

2-21. TIME MEASUREMENTS (Figure 2-15)

a. ELAPSED TIME MEASUREMENTS

Any horizontal distance on the screen of the oscilloscope can be used to represent a precise interval of time when the time-base circuits are set up for calibrated sweep (PULL VARIABLE control "in"). Use of this feature permits you to accurately measure the elapsed time between the desired point of interest on the display. To measure the time interval, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters between that portion of the display whose time interval you wish to find.

2. Multiply the horizontal dimension obtained in step 1 by the TIME/CM control setting to obtain the time interval. See Figure 2-15.

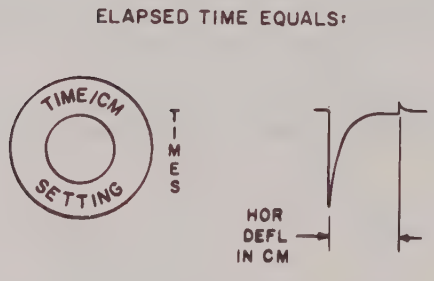


FIGURE 2-15. ELAPSED TIME MEASUREMENT

b. HOW TO FIND REPETITION RATE OR FREQUENCY (Figure 2-16)

The repetition rate or frequency for periodic signals can be expressed as the number of cycles or pulses per unit of time. To use the oscilloscope for measuring the repetition rate or frequency of periodic signals, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters occupied by one cycle of the display under observation.

2. Multiply the horizontal dimension obtained in step 1 by the TIME/CM control setting.

3. Take the reciprocal of the product obtained in step 2 (that is, divide it into one). The resulting quotient is the desired frequency or repetition rate in cycles per second. See Figure 2-16.

$$\text{Cycles/second} = \frac{1}{\text{Time (seconds)}}$$

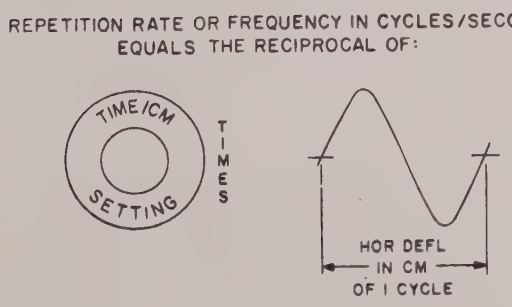


FIGURE 2-16. FINDING THE FREQUENCY

2-22. PHASE SHIFT MEASUREMENTS (Figure 2-17)

Phase shift measurements are usually made when the frequencies of the two input ac signals are equal. Hence, Lissajous figures that results from a phase difference between two input signals of the same frequency are often referred to as phase difference patterns. When the frequencies of the two input signals are not a 1:1 ratio, the Lissajous figures are generally used for frequency measurements.

To check the relative phase shift, proceed as follows:

1. Apply a sine wave signal to both the X and Y INPUT.

2. Center the trace horizontally and adjust the Y controls for 10 centimeters of vertical deflection. The pattern obtained should be similar to Figure 2-17.

3. The angle between the two signals is that angle whose sine is the ratio of A/B.

NOTE: To obtain full scale vertical deflection of 10 centimeters, it may be necessary to temporarily reduce the horizontal amplitude of the display. To accomplish this, set the X VOLTS/CM switch one step counterclockwise from its initial setting. Adjust the display for 10 centimeters of vertical deflection. Reset X VOLTS/CM switch to its original setting, recenter the display, and read dimension A in Figure 2-17.

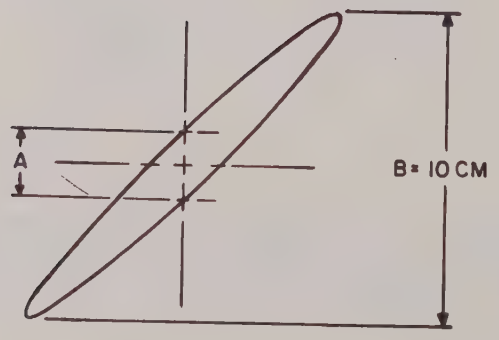


FIGURE 2-17. PHASE SHIFT MEASUREMENT

A choice of AC or DC or AC STAB coupling is available for the above inputs. The AC STAB setting is used to minimize the low-frequency drift. Sensitivities above 100 uV/CM are automatically AC STABilized (green sector).

The UPPER BEAM SENSITIVITY switch consists of compensated RC networks permitting the desired attenuation of the input signal in 19 calibrated steps from 10 microvolts/cm to 10 volts/cm. In the CAL position, the calibrator signal is applied to the grid of the input amplifier V110A, and may be used to calibrate the oscilloscope. When gains are normalized, the peak-to-peak value of the calibrator waveform will indicate 4 centimeters of vertical deflection on the screen. The design of the calibrated attenuator provides a constant input impedance of 1 megohm and 50 picofarads at all settings of the SENSITIVITY switch.

The RC networks, R1101 and C1103, and R1104 and C1106, in series with the grid of V110A and V110B respectively, serve to protect the input circuit from damage due to excessive input voltage. The shunt capacitors preserve the high-frequency signal components.

b. Upper Beam Deflection Amplifier (Figure 3-2)

The vertical deflection hybrid amplifier consists of an input stage V110, a cathode follower impedance transformation stage V111, and a transistorized output stage Q1101 and Q1102. Practically all of the collector current from Q1101 and Q1102 is fed back to the cathodes of the input amplifier V110, through R1132 and R1133. These resistors serve as the collector load for Q1101 and Q1102 and are also part of the feedback circuitry. Application of this technique simplifies circuitry and insures amplifier stability.

Since the most sensitive ranges of the SENSITIVITY switch are part of the feedback circuitry, both the input attenuator and the VARIABLE control require balancing. The FINE and COARSE ATTEN BAL adjustments are provided to equalize the cathode voltages of V110A and V110B. In this way, impedance changes between these cathodes, caused by the switching of the SENSITIVITY feedback resistors are not reflected as pattern positioning changes on the screen. Therefore, when the amplifier is balanced, there will be no depositioning of the trace.

The PULL VARIABLE control is connected between the emitters of transistors Q1103 and Q1104 in the gain control stage. Any difference in the dc level between the two emitters will cause the trace to shift vertically as the VARIABLE control is rotated. The VARIABLE control is deactivated when the knob is pushed in. To use the VARIABLE control, pull the knob and rotate it for the desired amplitude.

The VERN BAL control is provided to equalize the collector voltage of Q1103 and Q1104 so that there is no depositioning of the trace on the screen when the PULL VARIABLE control is used.

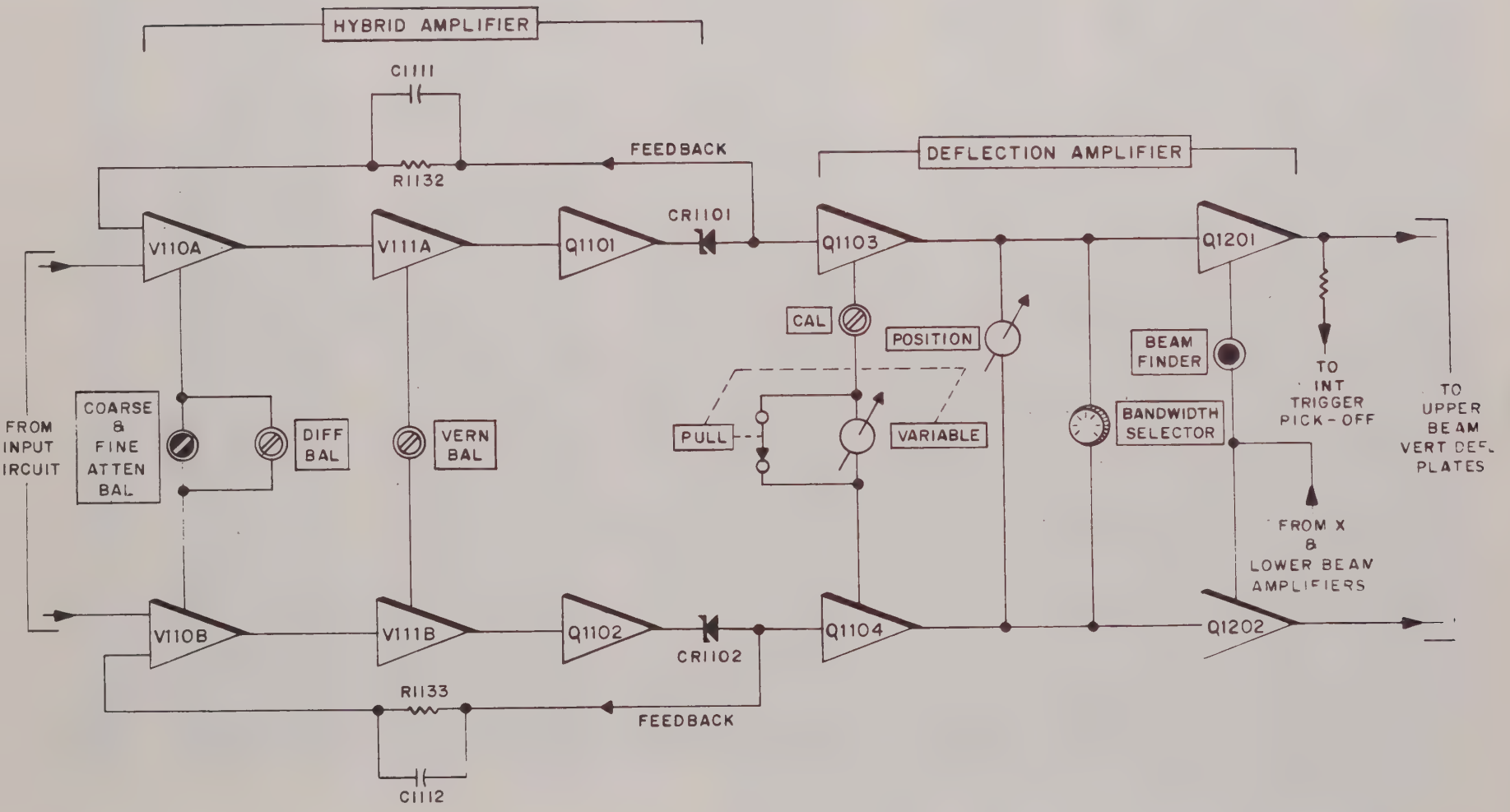


FIGURE 3-2. UPPER BEAM DEFLECTION AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM

SECTION 3

CIRCUIT DESCRIPTION

3-1. INTRODUCTION

To simplify circuit description of the Type 708A Oscilloscope, functional block diagrams are provided as follows:

Figure 3-1. Upper Beam Input Circuit, Simplified Functional Block Diagram

Figure 3-2. Upper Beam Deflection Amplifier, Functional Block Diagram

Figure 3-3. X Input Circuit, Simplified Functional Block Diagram

Figure 3-4. X Deflection Amplifier, Functional Block Diagram

Figure 3-5. Trigger Circuit, Functional Block Diagram

Figure 3-6. Sweep Generator, Simplified Block Diagram

The circuit description will be keyed to the aforementioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be referred to in following the circuit description. Refer to Figure 5-1 in the Maintenance and Recalibration Section for the over-all block diagram.

3-2. UPPER BEAM DEFLECTION SYSTEM

a. Input Circuit (Figure 3-1)

The Type 708A Oscilloscope consist of two identical vertical deflection amplifiers (Upper Beam & Lower Beam) the output of which is applied to separate vertical deflection plates. Since the amplifiers are identical, the circuit description will refer to the Upper Beam amplifier only. Operation of the Lower Beam amplifier will be the same as the Upper Beam unless otherwise noted.

The Y Input Selector switch provides for the following selections:

1. Input A only.
2. Input-B only; inverted polarity.
3. Inputs A &-B for differential display.

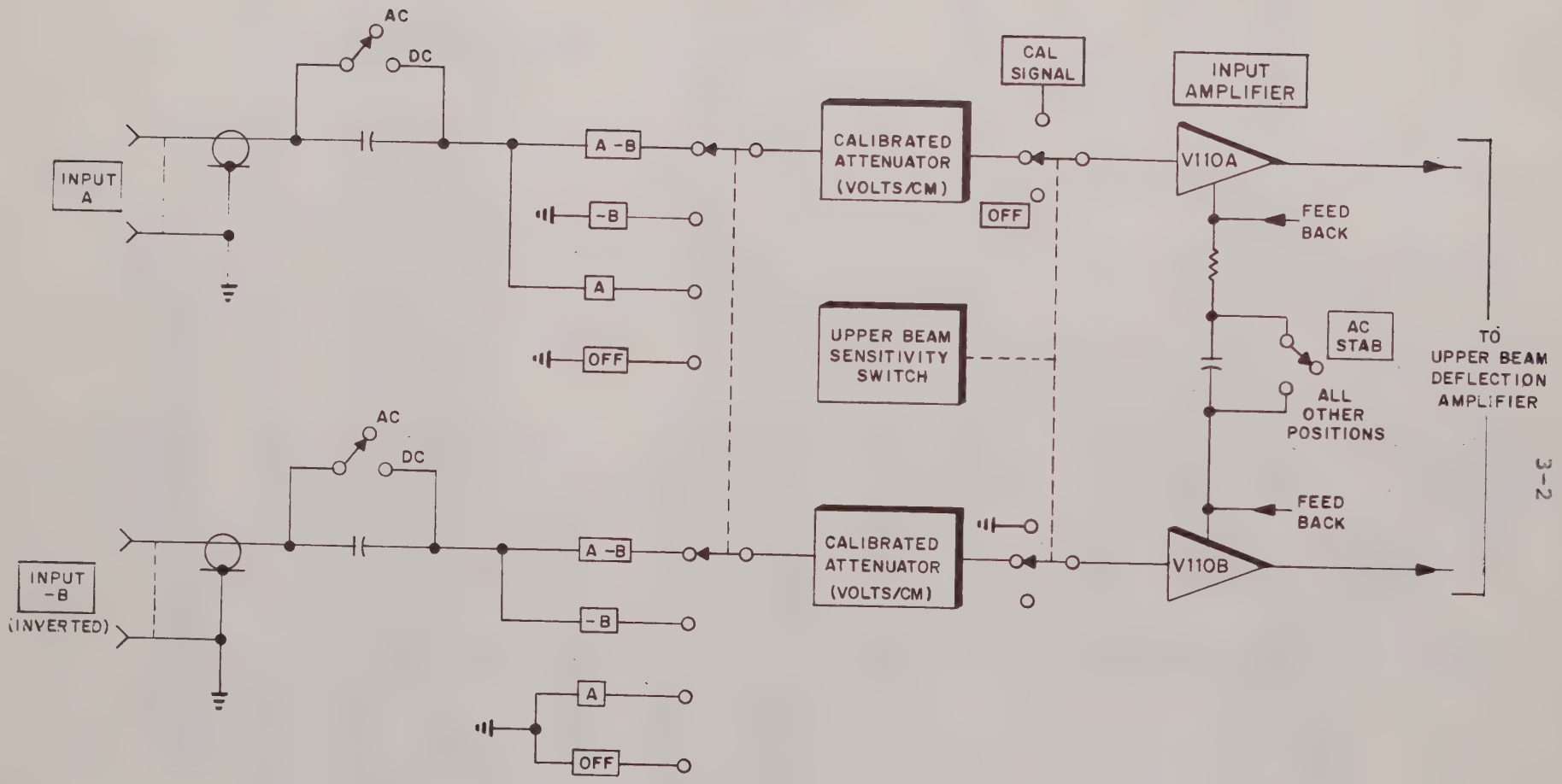


FIGURE 3-1. UPPER BEAM INPUT CIRCUIT, SIMPLIFIED FUNCTIONAL BLOCK DIAGRAM

In the CAL position, the calibrator signal is applied to the input of V110 and may be used to normalize the oscilloscope. The CAL 4CM front-panel screwdriver controls sets gain of amplifier at low sensitivity end (black sector) or high sensitivity end (green sector) for a specific deflection of 4CM to insure accuracy of vertical amplitude measurements.

The X and Y DP LEVEL ADJ potentiometers (R5036 and R1216) are provided to set the X deflection plate average potential equal to the Y deflection plate average potential (approximately 105 volts above chassis ground).

The BEAM FINDER is a momentary contact switch that electrically reduces the output amplifier window and scales down the display. This action brings the beam or trace on screen, then allows centering with the POSITION controls. If no spot or trace appears when the BEAM FINDER button is depressed, either the INTENSITY control has to be advanced or else the sweep is not running. It may aid the operator to set up the instrument for AUTOmatic triggering in an endeavor to obtain a trace on the screen.

The BANDWIDTH Selector switch provides three selectable bandpasses as indicated on front-panel to insure optimum performance at the higher amplifier sensitivities.

A phase shift trimmer C1208, is added across the output of the upper beam deflection amplifier Q1201 and Q1202. This trimmer enables an operator to optimize the phase shift differential between the X and Y amplifiers for a particular application. When C1208 is not adjusted for phase balance at a particular frequency, it should be set for minimum capacity to give maximum Y amplifier response. The upper beam vertical deflection plates are driven directly from the transistorized amplifier Q1201 and Q1202. The lower beam deflection amplifier is not provided with a phase shift trimmer.

3-3. HORIZONTAL DEFLECTION SYSTEM (Figures 3-3 and 3-4)

The X DISPLAY switch provides for the following selections:

1. Time Base
2. External Signals
3. Lower Beam Vertical Deflection Amplifier

External signals may be applied to the X INPUT terminals for single-ended input. The time base signal is obtained from the sweep circuit and is applied to the X horizontal deflection amplifier when the X DISPLAY switch is set to SWEEP. The internal sweep may be expanded by factors up to 50 via the calibrated X deflection system.

The EXPAND lamp is lit whenever the X DISPLAY switch is set up for expanding the internal sweep. The lamp is not lit in X1 position of the sweep EXPAND sector.

The XV/CM sector of the X DISPLAY switch provides the desired attenuation of the X INPUT signal in 6 calibrated steps from 20 mV/CM to 1 volt/cm.

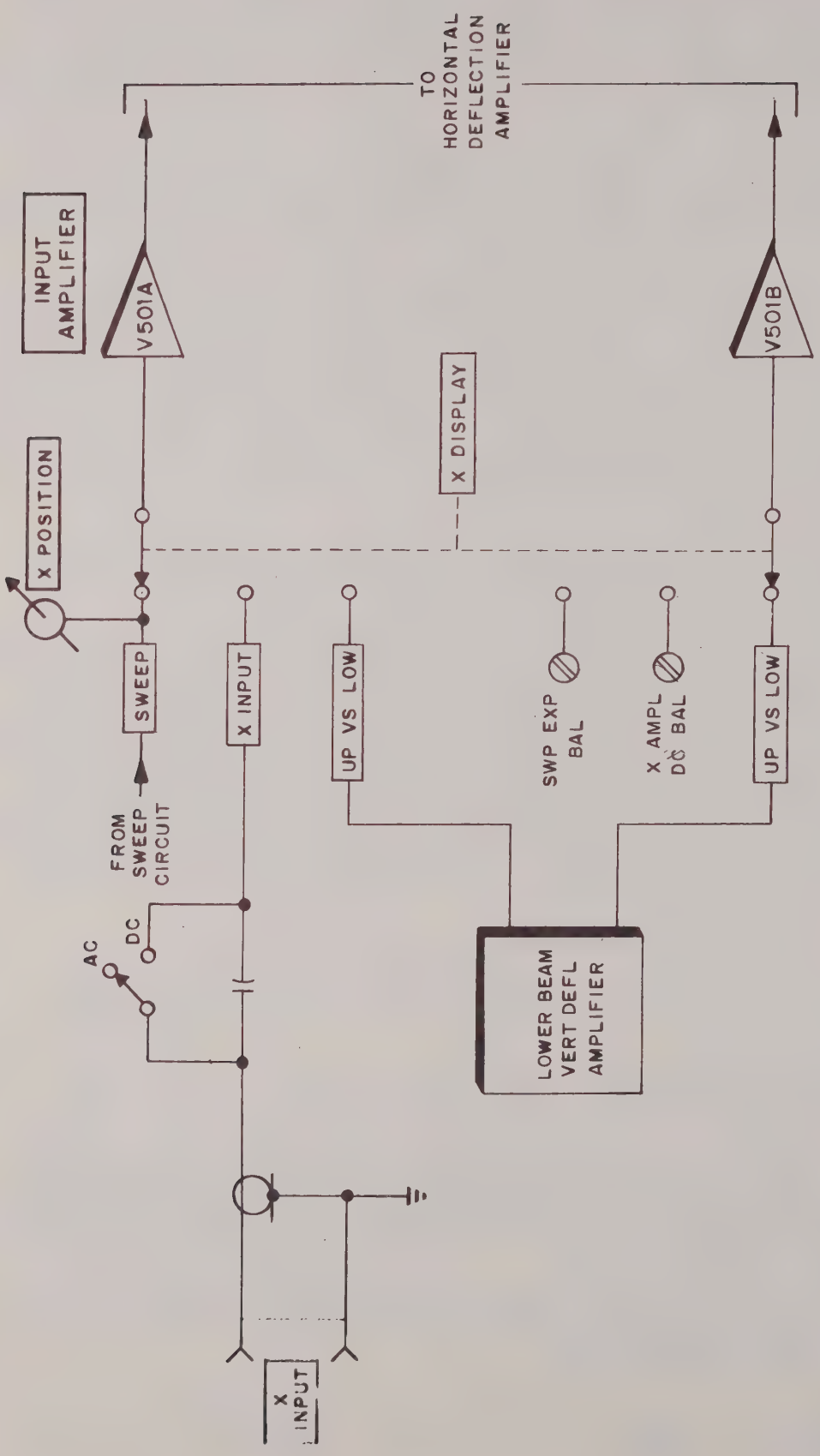


FIGURE 3-3. X INPUT CIRCUIT, SIMPLIFIED FUNCTIONAL BLOCK DIAGRAM

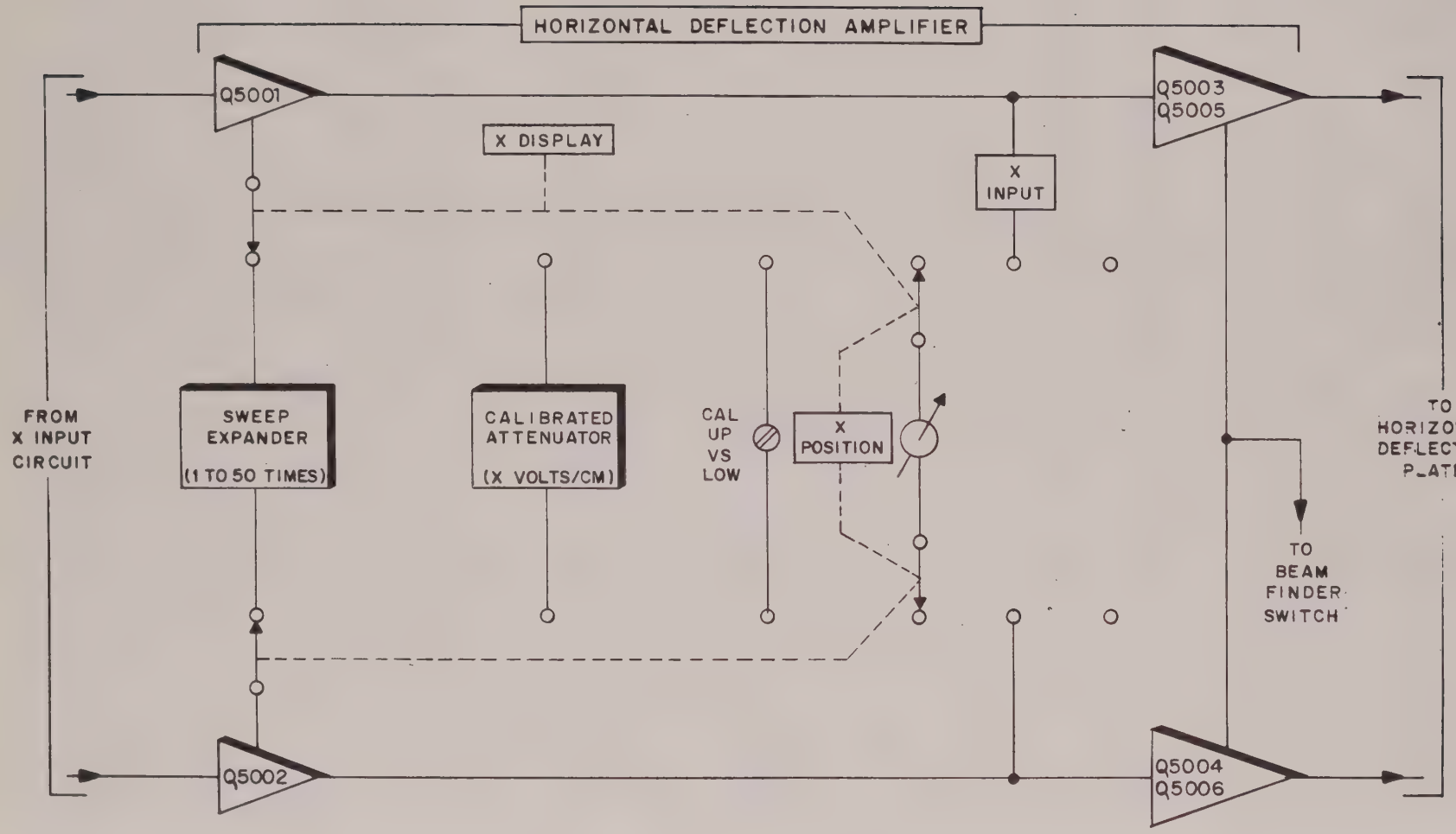


FIGURE 3-4. X DEFLECTION AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM

In the Upper Beam vs Lower Beam position of the X DISPLAY switch, the internal sweep is disconnected and the output from the Lower Beam Amplifier is connected to the horizontal deflection plates for X-Y plotting.

The horizontal deflection plates are driven directly from transistorized amplifier Q5005 and Q5006.

3-4. TRIGGER CIRCUIT DESCRIPTION (Figure 3-5)

a. Trigger Input

The input to the trigger amplifier, V401, may be selected from one of three sources via the Trigger Selector switch as follows:

1. In EXT position, the signal is obtained from an external source through the EXT TRIG front-panel connector.

2. In INT UPPER or LOWER position, the signal is derived from their respective beam deflection amplifier.

3. In LINE position, the signal is tapped from one side of the 6.3 VAC heater circuit.

A choice of AC, LF REJECT, or DC coupling is provided by the Trigger Selector switch. In the AC position, the trigger signal is applied to a high-pass filter consisting of C4002, C4003, and R4002 providing a low-frequency cutoff of 80 cycles. The cutoff frequency is raised to 15 KC in the LF REJECT position and the high-pass filter now consists of C4003 and R4005. In the DC position, the high-pass filters are disconnected and the triggering signal is applied directly to the trigger amplifier. The RC network, R4004 and C4004, in series with the grid of V401, serves to protect the input circuit from damage to excessive input voltage. Shunt capacitor C4004, preserves the high-frequency signal component.

b. Trigger Amplifier

The trigger amplifier, V401, is a cathode-coupled amplifier. Output is always taken from the B-Section plate (pin 6). For positive-going signals, connection is made to the grid of V401B (pin 7), and for negative-going signals, connection is made to the grid of V401A (pin 2). In each case, the opposite grid is connected to a dc bias source, adjustable by means of the TRIG LEVEL control R4007.

The TRIG LEVEL control is used to select the level of the triggering point for all settings of the Trigger SLOPE switch. When the TRIG LEVEL control is rotated fully clockwise to AUTO, the sweep is self-triggered in the absence of a triggering signal. As you rotate the control away from the AUTO position, the automatic sweep feature will cease. Continued rotation of this control will permit the operator to adjust the triggering level of the pattern within the limits specified in Section 1.

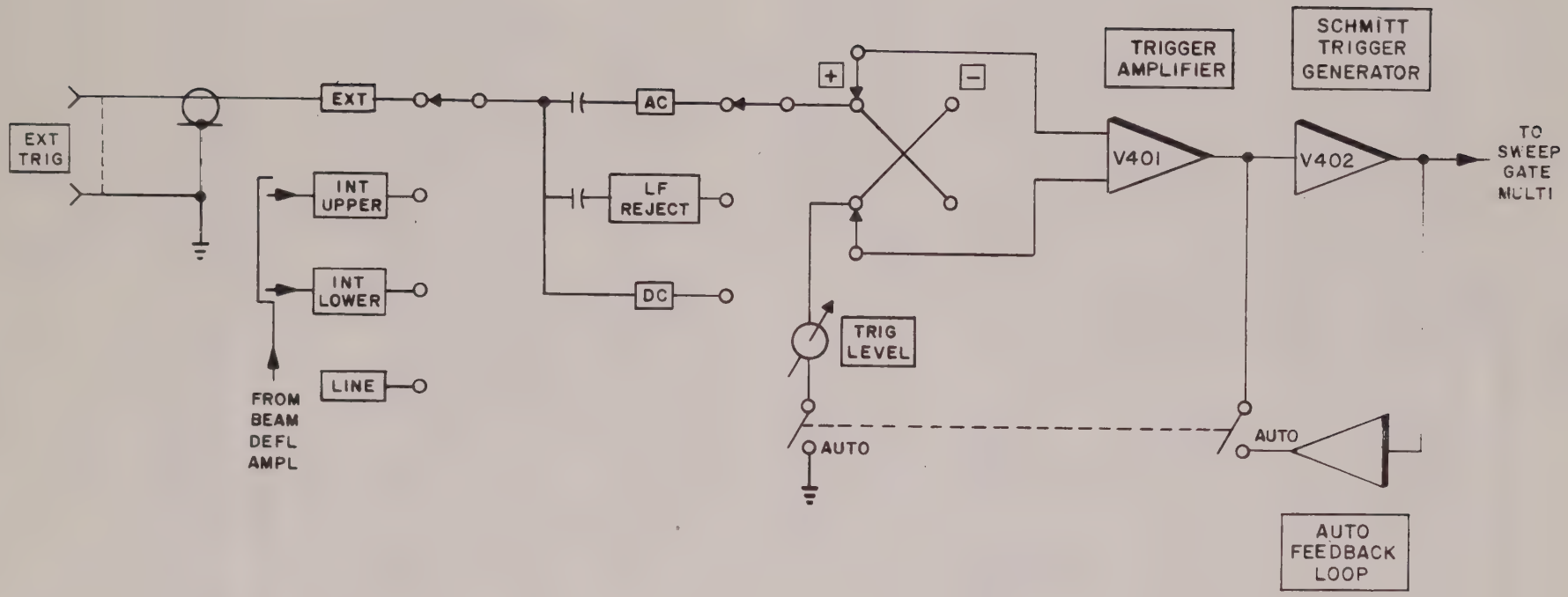


FIGURE 3-5. TRIGGER CIRCUIT, FUNCTIONAL BLOCK DIAGRAM

c. Schmitt Trigger Generator and Auto Triggering

The Schmitt Trigger Generator is essentially a regenerative amplifier signal level selector. It consists of a two-stage amplifier, V402A and V402B, having a dc plate-to-grid coupling from A to B amplifier and dc cathode-to-cathode coupling. The circuit has two stable states: the A side conducting, the B side at cutoff; the B side conducting, the A side at cutoff. The transition from one state to the other is abrupt, producing fast rise and fall times from each side of the circuit.

The dc voltage applied to the grid of V402A determines which state the circuit will be in. Assume operation as follows: V402A is conducting and V402B at cutoff. V402B will remain at cutoff until the amplitude of a positive-going signal applied to its grid reaches the threshold level of conduction. When this threshold level is exceeded, an abrupt transition from cutoff to full conduction will occur in V402B. Simultaneously, V402A will promptly stop conduction. V402A and V402B will revert to their original condition when the amplitude of the initiation signal falls slightly below the threshold level of conduction for V402B.

In general, the threshold voltage is higher when moving the grid in a positive direction, and lower when moving the grid in the negative direction. The two different voltage levels are called the "upper and lower hysteresis limits" of the Schmitt Trigger Generator. The hysteresis offset basically represents the input peak-to-peak voltage sensitivity of the trigger system.

The initial A-side grid level can be positioned anywhere inside or outside of the hysteresis area, thus establishing the input voltage required to change the state of V402A. The steady state grid bias of V402A is normally determined by the TRIG LEVEL control setting.

When the TRIG LEVEL control is set to AUTO, the trigger amplifier is ac coupled to the input grid of the Schmitt Trigger Generator through C4008, and the feedback resistor, R4024, is connected between the grids of the Schmitt Trigger Generator. This causes V402A and V402B to flip back and forth yielding about 50 pulses per second in the AUTO position. Thus, a horizontal reference trace will appear on the screen even in the absence of an input signal.

3-5. SWEEP CIRCUIT (Figure 3-6)

a. Sweep Gate Multivibrator

The output from the Schmitt Trigger Generator is differentiated by C4107 and R4142 and applied to the grid of V411A through turn-on diode CR4107.

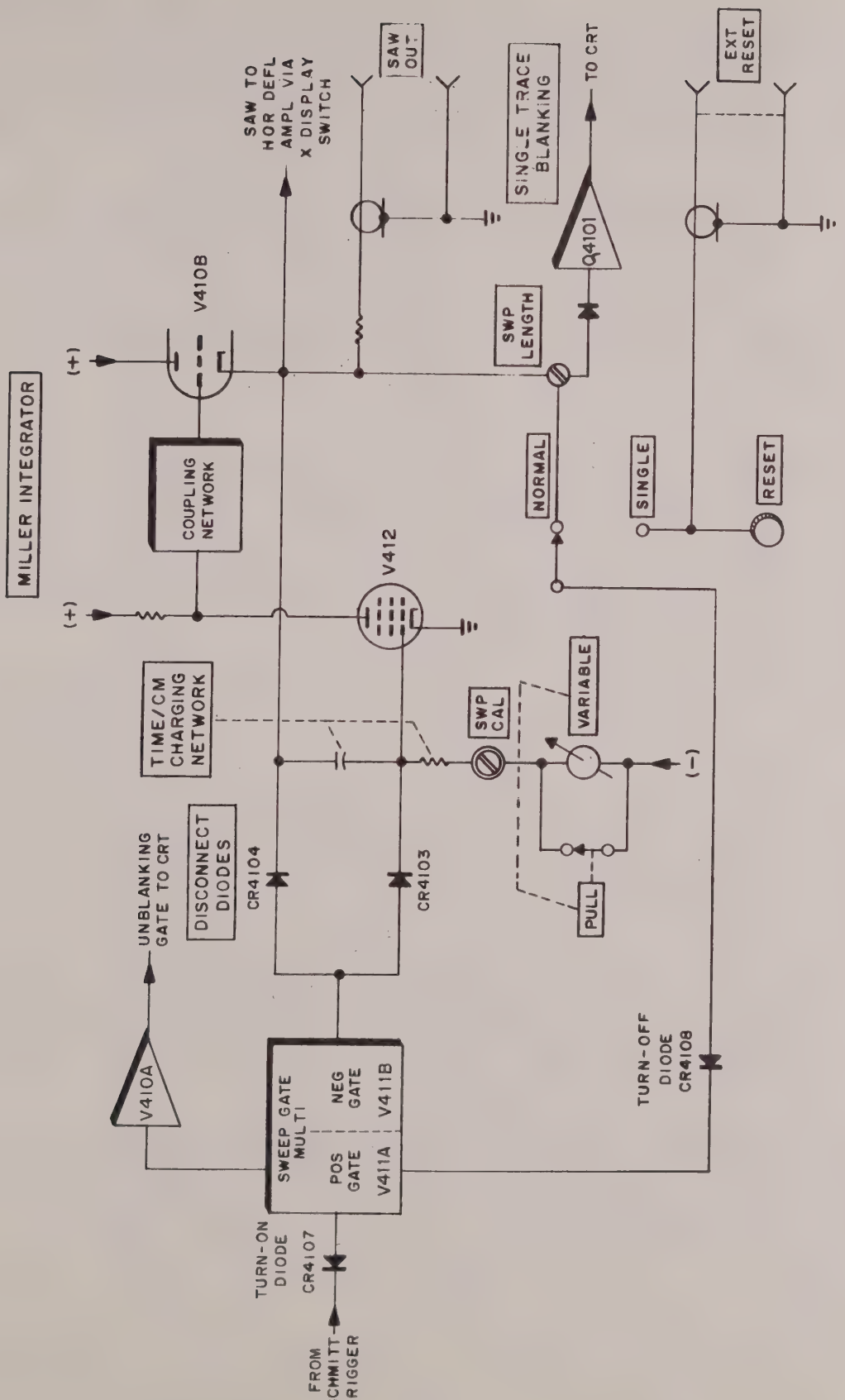


FIGURE 3-6. SWEEP GENERATOR, SIMPLIFIED BLOCK DIAGRAM

The dc coupled bistable multivibrator, C3501A and V3501B, initiates the formation of the sweep after receiving a negative trigger from the Schmitt Generator. Diode CR4107 and the lockout circuit hold off subsequent triggering signals until after the sweep is completed. In the quiescent state, V411A is conducting and V411B is at cutoff. V411A forms a negative gate during the forward sweep interval.

CR4107 performs two functions: 1) it serves as a low-capacitance coupling diode to couple the negative trigger from the Schmitt Generator to initiate the sweep, and 2) it serves as a high back-impedance diode to decouple the Trigger Generator from the sweep gate multivibrator. After the bistable multivibrator has been triggered, it will revert to its original state as determined by the setting of the LENGTH adjustment, R4141.

b. Saw Generation

The saw generator is of the Miller "run-up" type, V412. The negative output developed at the plate of V411B is applied to the anodes of the disconnect diodes, CR4103 and CR4104. The anode voltages of these diodes are now below their cathodes, and the diodes no longer conduct. This action removes the restraint imposed on the sweep-charging network and now permits the selected sweep capacitor to charge linearly through the associated resistance network.

When the grid of the Miller integrator moves negatively, the plate voltage rises positively carrying the saw cathode-follower grid, cathode (V401B) and timing capacitor in the same direction. Thus, the positive voltage swing on the opposite side of the timing capacitor tends to prevent the grid side from swinging negatively. It also increases the voltage to which the timing capacitor is trying to charge. The net result is to straighten out the charging curve (sweep voltage) by maintaining a constant current flow in the capacitor.

Since the grid of V412 remains at a constant potential within a small fraction of a volt, the current through the charging resistor remains constant and the sweep timing capacitor thus charges at a constant rate. The resulting linear sawtooth waveform is applied to the horizontal deflection system when the X DISPLAY switch is set to the SWEEP sector.

The EXPAND sector (green numerals) of the X DISPLAY switch provides horizontal magnification of the sweep about the screen center by factors of 1, 2, 5, 10, 20, and 50. Any portion of the expanded display may be observed by adjusting the POSITION control.

When a NORMAL/SINGLE switch is set to SINGLE, the saw turn-off diode CR4108 is disconnected from the LENGTH potentiometer R4141. Thus only a single trace will now sweep across the screen when the sweep is triggered. At the end of its travel, the beam will rest off screen because the sweep gate multivibrator is locked in this position. To reset or rearm the sweep, push the momentary contact RESET button. Refer to the Operating Instructions Section for application of this technique.

c. Sweep Length

The sweep length, or the total duration of the sweep for any given sweep rate is determined by the setting of the Sweep LENGTH adjustment, R4141. A portion of the positive sawtooth voltage is fed back to the saw turn-off diode CR4108. If the Sweep LENGTH potentiometer is properly set, diode CR4108 will conduct when the positive-going excursion of the sawtooth has travelled 10.5 to 11 centimeters on the screen. This positive peak signal will then be conducted through diode CR4108 to the grid of V411A. Upon receiving this positive pulse, the sweep gate multivibrator will revert rapidly to its original state with V411A conducting, and V411B at cutoff. The positive step from the plate of V411B returns the disconnect diodes, CR4103 and CR4104, back to their conducting state thus discharging the timing capacitors. The Miller circuit now returns to its quiescent level and is ready for the next trigger after the lockout time interval is completed.

d. Lockout Circuit

The lockout circuit prevents the sweep gate multivibrator from being triggered until the sweep retrace interval has reverted to the quiescent base level. The sweep does not retrace in zero time since the clamping of the Miller integrator timing capacitor is accomplished with a diode switch having a small impedance. The timing circuit discharge (saw retrace) takes longer than the flipping of the sweep gate multivibrator. Consequently, the trigger excitation pulses must be held off to prevent the formation of a new saw during the retrace interval of the preceding saw. This last or preceding sawtooth waveform must be permitted to retrace completely to its quiescent base which re-establishes the beam to the left-hand side of the CRT screen. This is accomplished by holding the cathode of the TURN-ON diode, CR4107, at a suitable positive voltage for a given period after the completion of the sweep.

During the forward sweep interval, a portion of the positive gate voltage is fed back through R4135 to charge the lockout capacitor through coupling diode, CR4109.

During the return-trace interval, diode CR4109 is cut off and the lockout capacitor is discharged through R4143. The sweep gate multivibrator will not reset until the appropriate lockout timing capacitor has been discharged. The value of this capacitor is chosen to give lockout, beyond the time that the sweep has returned to rest at its initial starting point. The duration of the lockout interval is determined by the sweep charging time constant and the Miller integrator clamp. Consequently, the TIME/CM switch must also change the lockout circuit hold-off timing capacity. This technique prevents additional triggers from energizing the sweep during retrace interval.

The trigger coupling diode, CR4107, prevents triggers from disturbing the sweep gate multivibrator during all of the sweep-forward interval and the lockout circuitry during the retrace interval.

e. Unblanking

The cathode-ray-tube employed in this oscilloscope has two additional beam deflecting plates which cut off the electron beam independently of the control grid.

In beam gate blanking, the electron beam is always turned on and passes through an aperature in the center of a blanking shield. Behind this shield is a set of deflection plates, one of which is connected to a fixed potential while the second deflection plate is connected to the unblanking gate. When the time base is sweeping, both deflection plates are at the same potential and the electron beam passes through the aperature in the blanking shield. When the sweep ends and the unblanking gate voltage increases, the beam is deflected behind the blanking plate and the screen is dark. Beam control pulses (trace brightening and retrace blanking pulses) can easily be dc coupled since these beam deflection plates are electrically close to ground. In conventional circuits these pulses must be coupled to a high-potential control grid.

The extra beam deflection plates are controlled by the sweep gate multivibrator, V411. A positive gate is developed at the plate of V411A and is coincident with the sweep forward time. This pulse is applied to the beam deflection plate of the cathode-ray-tube through cathode follower V410A. Hence the display is visible only during the forward sweep interval and is blanked during the retrace and lockout interval.

When the TIME/CM switch is set to OFF, one side of the sweep gate multivibrator is ungrounded thus disabling the sweep circuit and turning on the beam. The horizontal deflection amplifier may now be set up to receive external signals.

If blanking is desired with the X signal (electronic shutter operation), the TIME/CM switch may be set to any position except OFF, thus activating the sweep gate multivibrator. The degree of blanking is then controlled by settings of the TIME/CM controls. Refer to Operating Instructions Section for additional information.

3-6. LOW-VOLTAGE POWER SUPPLY

a. Power Transformer

Plate and heater power for this instrument is provided by a single power transformer, T6001. The primary is wound with two equal 115-volt windings that can be connected either in parallel for 115-volt operation, or in series for 230-volt operation.

b. Regulated Supplies

Four regulated supplies are provided with outputs as follows:

+160 volts, +59 volts, -12.6 volts, and -50 volts

All of the regulated supplies are of the constant-output voltage series-passing type. The basic reference for all of the regulated supplies is the fixed drop across V601. This gas diode, V601, maintains a constant voltage drop of about 85 volts across itself within a broad current range.

Operation of the other low-voltage regulated supplies is identical, so only the +160-volt supply is described. CR6001 to CR6004 are connected in a conventional bridge rectifier circuit. The rectified output is capacitively filtered by C6001. Resistor R6000 shunts the filter capacitor to leak off the charge when the instrument is turned off as a safety measure.

The filtered rectified output is applied to Q6001 and Q6002, series-passing transistors whose voltage drop is adjusted by the feedback voltage from R6013R through the dc amplifier Q6003. Assume the output voltage tends to decrease. This will lower the base voltage of the error detector amplifier Q6003. The resulting increase in voltage at the collector of Q6003 is applied to the bases of the series-passing transistors. The resultant voltage change in the series-passing transistors Q6001 and Q6002 is such as to return the output voltage to its proper value.

c. Voltage Calibrator

The power-line frequency voltage from T6001 is applied to the base of voltage calibrator Q6100 through limiting resistor R6102. Negative and positive excursions will drive the transistor into and out of conduction at double the line-frequency rates. The resulting waveform from the collector of Q6100 is applied to a pair of voltage deviders. The attenuated output is coupled to the beam deflection amplifiers

3-7. CRT CIRCUIT

a. CRT Beam Control Circuits

The INTENSITY control R7036, part of the negative high-voltage divider, is used to vary the cathode-ray-tube grid voltage to adjust the beam current. The INTENSITY BALANCE control R7031 is provided to vary the upper trace brightness when rotated to the right.

The upper and lower beams are each provided with their separate FOCUS and ASTIG controls. The FOCUS control (UPPER or LOWER) is provided to vary the voltage at the focusing anode to set the second cross-over point right at the screen of the cathode-ray-tube. The ASTIGmatism control (UPPER or LOWER), is provided to vary the voltage in the astigmatism anode to focus the spot in both axes simultaneously.

The PATTERN ADJ potentiometer R7046F is set to vary the field the cathode-ray-tube encounters as it emerges from the deflection control system to control the linearity at the extremes of deflection.

The TRACE ALIGN front-panel screwdriver control R7049 is provided to vary the current through coil L7001 around the neck of the CRT. The current varies the field strength which the CRT beam intercepts causing it to rotate. This function is used to compensate for the earth's magnetic effect on trace alignment.

b. High Voltage Power Supply

Accelerating voltages for the cathode-ray-tube are obtained by rectifying a 30-KC high voltage produced by transistor oscillator Q7004. This transistor is connected as a Class C oscillator with the primary of transformer T7001 tuned by the strayed capacitance and the reflected secondary impedance.

The output of the oscillator is stepped up by T7001 and applied via a conventional solid state double network consisting of CR7005 and CR7004 to the post-deflection accelerator of the cathode-ray-tube.

The negative high-voltage supply is derived from a tap on the secondary winding of transformer T7001 which is connected to a half-wave rectifier CR7003. The rectified output of -982 volts is capacitively filtered by C7013, C7014, and C7016 and provides the necessary operating potentials for the proper intensity and focusing of the cathode-ray-tube.

Regulation of the high voltage negative supply is accomplished by sampling a portion of the rectified output and applying a correction signal back through the HV regulator Q7003 to Q7001 to the base of the HV oscillator Q7004. This action changes the amplitude of oscillation of Q7004 and T7001 in such a manner as to restore the high voltage output to its preset level. Potentiometer R7017, HV ADJ, is provided to preset the output of the high-voltage supply to its proper level.

SECTION 4

PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The test described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance of the instrument. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5 for list of test equipment required.

> NOTE
>
> If this oscilloscope is checked by a receiving inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence it is suggested that the certifying engineer try the recommended adjustments to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined below, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

4-2. INITIAL SETUP

If the controls are set exactly as shown in Figure 4-1 in the sequence indicated, three cycles of the calibrator signal will be displayed on screen. The procedure just given is a good over-all check of the Type 708A Oscilloscope.

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.

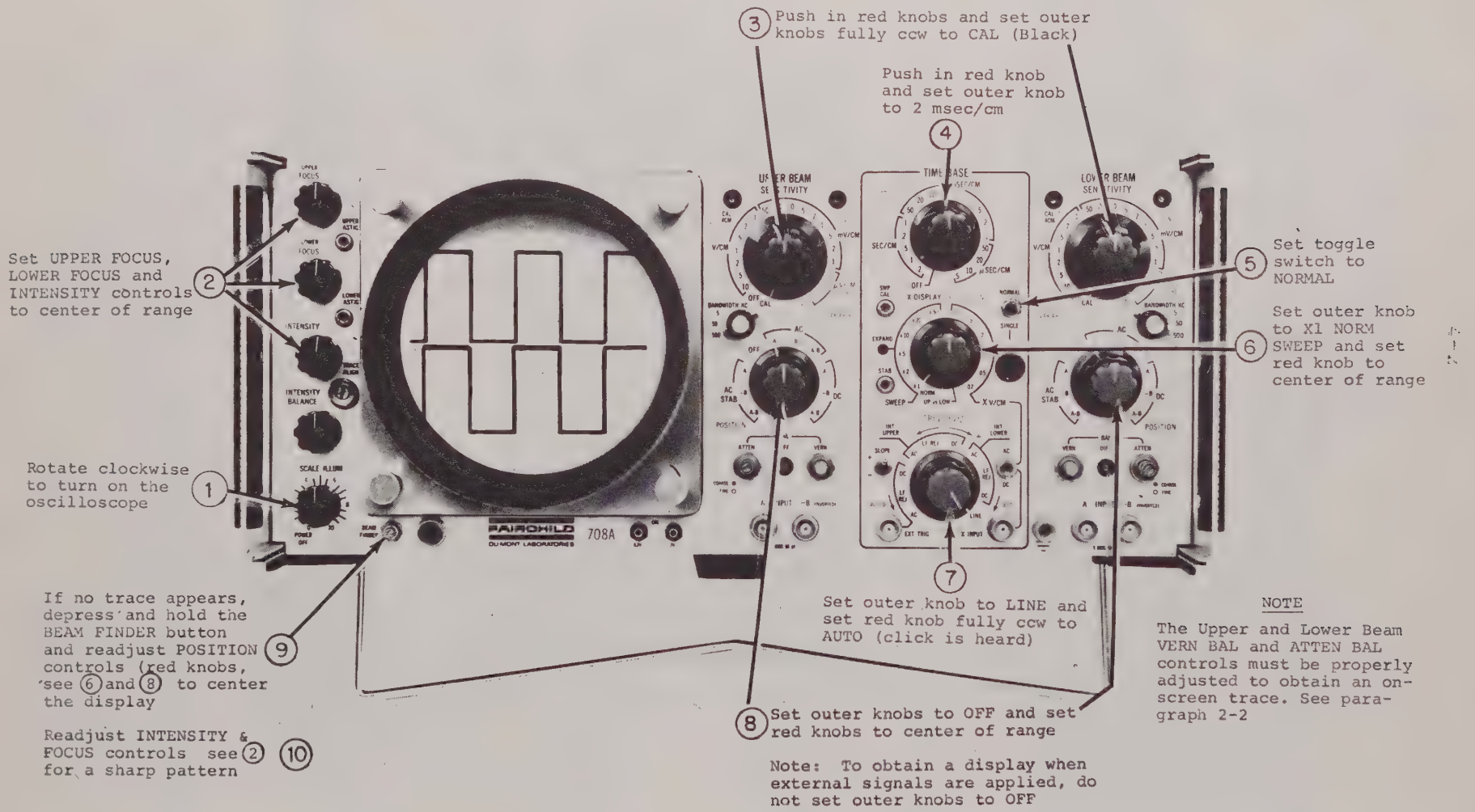

3 Push in red knobs and set outer knobs fully ccw to CAL (Black)
Push in red knob and set outer knob to 2 msec/cm
4
Set UPPER FOCUS, LOWER FOCUS and INTENSITY controls to center of range
2
5 Set toggle switch to NORMAL
Set outer knob to X1 NORM SWEEP and set red knob to center of range
6
Rotate clockwise to turn on the oscilloscope
1
7 Set outer knob to LINE and set red knob fully ccw to AUTO (click is heard)
If no trace appears, depress and hold the BEAM FINDER button and readjust POSITION controls (red knobs, see 6 and 8) to center the display
9
Readjust INTENSITY & FOCUS controls see 2 for a sharp pattern
10
8 Set outer knobs to OFF and set red knobs to center of range
Note: To obtain a display when external signals are applied, do not set outer knobs to OFF
NOTE
The Upper and Lower Beam VERN BAL and ATTEN BAL controls must be properly adjusted to obtain an on-screen trace. See paragraph 2-2
FAIRCHILD
708A

FIGURE 4-1. INITIAL SETUP OF TYPE 708A OSCILLOSCOPE

4-3. CHECKING X VOLTS/CM SWITCH

The XV/CM switch is the right sector of the X DISPLAY switch. To check proceed as follows.

1. Apply the output of a Ballantine Calibrator to the X INPUT connector.

2. Check all ranges of the XV/CM sector of the X DISPLAY switch as outlined in Table 4-1.

TABLE 4-1
DEFLECTION CALIBRATION CHECK

XV/CM Setting	Generator Output Voltage (Peak-To-Peak)	Centimeters of Deflection
1.0	8V	8, ±0%
0.5	4V	8, ±2.4mm
0.2	1.6V	8, ±2.4mm
0.1	800mv	8, ±2.4mm
0.05	400mv	8, ±2.4mm
0.02	160mv	8, ±2.4mm

4-4. CHECKING SWEEP CALIBRATION

Sweep accuracy is checked by counting the number of positive pulses in the centered 8 cm portion of the graticule from 1 to 9 centimeters. To check sweep calibration proceed as follows.

1. Set the Upper and Lower PULL VARIABLE controls in their CAL (pushed-in) position.

2. Set the X DISPLAY switch to X1 NORM position.

3. Connect the output from a Fairchild Type 781A Time Mark Generator through a properly terminated cable, to the A INPUT connector on the Upper Beam amplifier.

4. Check the number of markers at each setting of the Sweep Speed switch as outlined in Table 4-2. All measurements should fall within ±2 mm of the 9 centimeter marking.

5. Disconnect the generator from the Upper Beam A INPUT connector and connect it to the Lower Beam A INPUT connector and repeat procedure.

TABLE 4-2

SWEEP CALIBRATION CHECK CHART

Time-Mark Generator Setting	Type 708A Sweep Speed Setting	Number of Positive Markers*
5 usec marker	5 usec	9 timing markers
10 usec marker	10 usec	9 timing markers
10 usec marker	20 usec	17 timing markers
50 usec marker	50 usec	9 timing markers
100 usec marker	0.1 msec	9 timing markers
100 usec marker	0.2 msec	17 timing markers
500 usec marker	0.5 msec	9 timing markers
1 msec marker	1 msec	9 timing markers
1 msec marker	2 msec	17 timing markers
5 msec marker	5 msec	9 timing markers
10 msec marker	10 msec	9 timing markers
10 msec marker	20 msec	17 timing markers
50 msec marker	50 msec	9 timing markers
100 msec marker	0.1 sec	9 timing markers
100 msec marker	0.2 sec	17 timing markers
500 msec marker	0.5 sec	9 timing markers
1 sec marker	1 sec	9 timing markers
1 sec marker	2 sec	17 timing markers

*Centered 8-cm portion of scale from 1 to 9-cm.

4-5. CHECKING SWEEP EXPANSION

1. Set the Upper and Lower PULL VARIABLE control in their CAL (pushed-in) position.

2. Set the X DISPLAY switch to X1 NORM position.

3. Connect the output from a Fairchild Type 781A Time Mark Generator through a properly terminated cable to the A INPUT connector on the Upper Beam amplifier.

4. Set the Sweep Speed switch in the 5 mSEC/CM position.

5. Check the number of markers at each setting of the X DISPLAY switch as outlined in Table 4-3.

TABLE 4-3

SWEEP EXPANSION CHECK CHART

Time Mark Generator Setting	Type 708A X Display Setting	Number of Positive Markers	Tolerance ± mm
5 mSEC	X1	9	1
5 mSEC	X2	4	4
500 uSEC	X5	17	4
500 uSEC	X10	9	4
500 uSEC	X20	4	4
50 uSEC	X50	17	4

4-6. CHECKING SWEEP VARIABLE CONTROL

1. Set the Sweep Speed switch to 1 mSEC/CM and the X DISPLAY switch to X1 NORM.

2. Connect the output from a Fairchild Type 781A Time Mark Generator through a properly terminated cable to the A INPUT connector of the Upper Beam amplifier.

3. Set the PULL VARIABLE in CAL (pushed-in) position and check display. There should be 1 marker per centimeter displayed.

4. Turn the PULL VARIABLE fully ccw and pull out and check display. There should be 3 or more markers per centimeter displayed.

4-7. CHECKING SINGLE SWEEP

1. Set up the instrument for a calibrator display.

2. Set the NORMAL/SINGLE switch to SINGLE and note that display is blanked out.

3. Depress the RESET lamp switch and note that trace sweeps across screen once and blanks out.

4. Repeat step 3 several times noting that sweep fires each time the RESET is depressed.

   NOTE: The Sweep Ready lite is located inside RESET switch and will illuminate each time the RESET switch is depressed.

5. Short EXT RESET connector located on rear of unit, to ground while observing display. It should perform in the same manner as the front-panel RESET switch.

4-8. CHECKING UPPER & LOWER BEAM ATTENUATOR SWITCHES

1. Preset the following front-panel controls as indicated:

Control	Setting
Input Selectors	A, AC Sector
X DISPLAY	X1 NORM
PULL VARIABLE	CAL (pushed-in)

2. Connect the output from a Ballantine Type 420 Calibrator to the A INPUT connector on the Upper Beam amplifier.

3. Check each setting of the SENSITIVITY switch as outlined in Table 4-4.

4. Disconnect the Calibrator from the A INPUT and connect it to the -B INPUT connector and repeat step 3.

5. Repeat this procedure to check the Lower Beam SENSITIVITY switches connecting the calibrator to the Lower Beam INPUT connectors.

TABLE 4-4

AMPLITUDE CALIBRATION CHECK

Calibrator Output Voltage Peak-To-Peak	Type 708A Sensitivity Setting	Centimeters of Deflection ±1.5mm unless Otherwise Stated
VOLTS 10	V/CM 10	1 ±0.3mm
VOLTS 10	V/CM 5	2 ±0.6mm
VOLTS 10	V/CM 2	5
VOLTS 5	V/CM 1	5
VOLTS 2.5	V/CM 0.5	5
VOLTS 1.0	V/CM 0.2	5
VOLTS 0.5	V/CM 0.1	5
MILLIVOLTS 250	mV/CM 50	5
MILLIVOLTS 100	mV/CM 20	5
MILLIVOLTS 50	mV/CM 10*	5
MILLIVOLTS 25	mV/CM 5	5
MILLIVOLTS 10	mV/CM 2	5
MILLIVOLTS 5	mV/CM 1	5
MILLIVOLTS 2.5	mV/CM 0.5	5
MILLIVOLTS 1.0	mV/CM 0.2	5
MILLIVOLTS 0.5	mV/CM 0.1	5
MICROVOLTS 250	uV /CM 50	5
MICROVOLTS 100	uV /CM 20	5
MICROVOLTS 50	uV /CM 10	5

*Check the PULL VARIABLE control in its uncalibrated position at this setting by rotating it fully ccw and pulling the knob out. Observe pattern, it should decrease to less than 2 cm. Return PULL VARIABLE control to its CAL (pushed-in) position and continue check.

4-9. CHECKING Y INPUT SELECTOR

1. Preset the following front-panel controls as indicated.

Control	Setting
SENSITIVITY (both)	0.5 V/CM
PULL VARIABLE (both)	CAL (pushed-in)
Sweep Speed	5 mSEC/CM
X DISPLAY	X1 NORM

2. Connect the output from the front-panel 2V jack to the A and -B INPUT connectors of the Upper Beam amplifier.

3. Check the display at all settings of the Input Selector switch. The A and -B positions should display 4 centimeters of vertical deflection. In the A-B positions the signal should cancel displaying a sweep with less than 2 millimeters of vertical deflection. In the OFF position a base line should be displayed.

4. Check the AC-DC input by setting the Selector to position A in the AC and AC STAB sector and observe display. A noticeable tilt should be observed in these positions over the A position of the DC sector.

5. Repeat procedure for the Lower Beam amplifier.

4-10. CHECKING COMMON MODE REJECTION

1. Set the Upper and Lower Beam SENSITIVITY switches on the 1.0 V/CM position.

2. Connect the output from a Ballantine Type 420 Calibrator, set for 6 volts peak-to-peak, to the A and -B INPUT connectors of the Upper Beam amplifier.

3. Set the Input Selector to A in the DC sector and check display for 6 centimeters of vertical deflection.

4. Set the Input Selector to -B in the DC sector and again check display for 6 centimeters of vertical deflection.

5. Set the Input Selector to A-B in the DC sector and the SENSITIVITY switch to 1.0 mV/CM.

6. Adjust the front-panel DIFF BAL screwdriver control for a null. The resultant display should be less than 1.0 cm.

7. Repeat procedure for the Lower Beam amplifier.

4-11. CHECKING X INPUT SELECTOR

1. Preset the following front-panel controls as indicated.

Control	Setting
X DISPLAY (XV/CM)	1
X Input Selector	DC
SENSITIVITY (upper	OFF

2. Position the spot to the left edge of the graticule.

3. Connect the output from a Ballantine Type 420 Calibrator, to the X INPUT connector.

4. Set the calibrator for 5 volts DC output and observe that spot moves to screen center ±2 mm.

5. Set the Input Selector to AC and observe that spot returns to left edge of graticule.

4-12. CHECKING 2V and .2V CAL SIGNALS

1. Set the Upper Beam SENSITIVITY switch to 0.5 V/CM and the Input Selector to A in the DC sector.

2. Connect the output of the front-panel 2V jack to the A INPUT connector on the Upper Beam amplifier.

3. Check display for 4 centimeters ±3% of vertical deflection.

4. Remove the connector from the 2V jack and connect it to the 0.2V jack.

5. Set the SENSITIVITY switch to 50 mV/CM and check display for 4 centimeters ±3% of vertical deflection.

4-13 CHECKING BANDWIDTH

1. Preset the following front-panel controls as indicated.

Control	Setting
BANDWIDTH KC (both)	500 KC
SENSITIVITY (both)	10 mV/CM
Input Selector (both)	A (AC Sector)
X DISPLAY	X1 NORM

2. Set up the instrument as shown in Figure 4-1.

3. Set the generator frequency to 1 KC and adjust its Output Amplitude Control for 6 centimeters of deflection on screen.

4. Record the meter reading.

5. Switch the test frequency to 500 KC and adjust the output of the generator to give the same reading on the VTVM as noted in step 4. The on screen deflection should not be less than 4.24 centimeters.

6. Repeat steps 4 and 5 with the BANDWIDTH switch set in the 50 KC position at a generator frequency of 50 KC.

7. Repeat step 4 and 5 with the BANDWIDTH switch and generator output set for 5 KC.

8. Disconnect the generator from the INPUT A connector of the Upper Beam amplifier and connect it to the INPUT A connector of the Lower Beam amplifier.

9. Repeat procedure to check the Lower Beam amplifier.

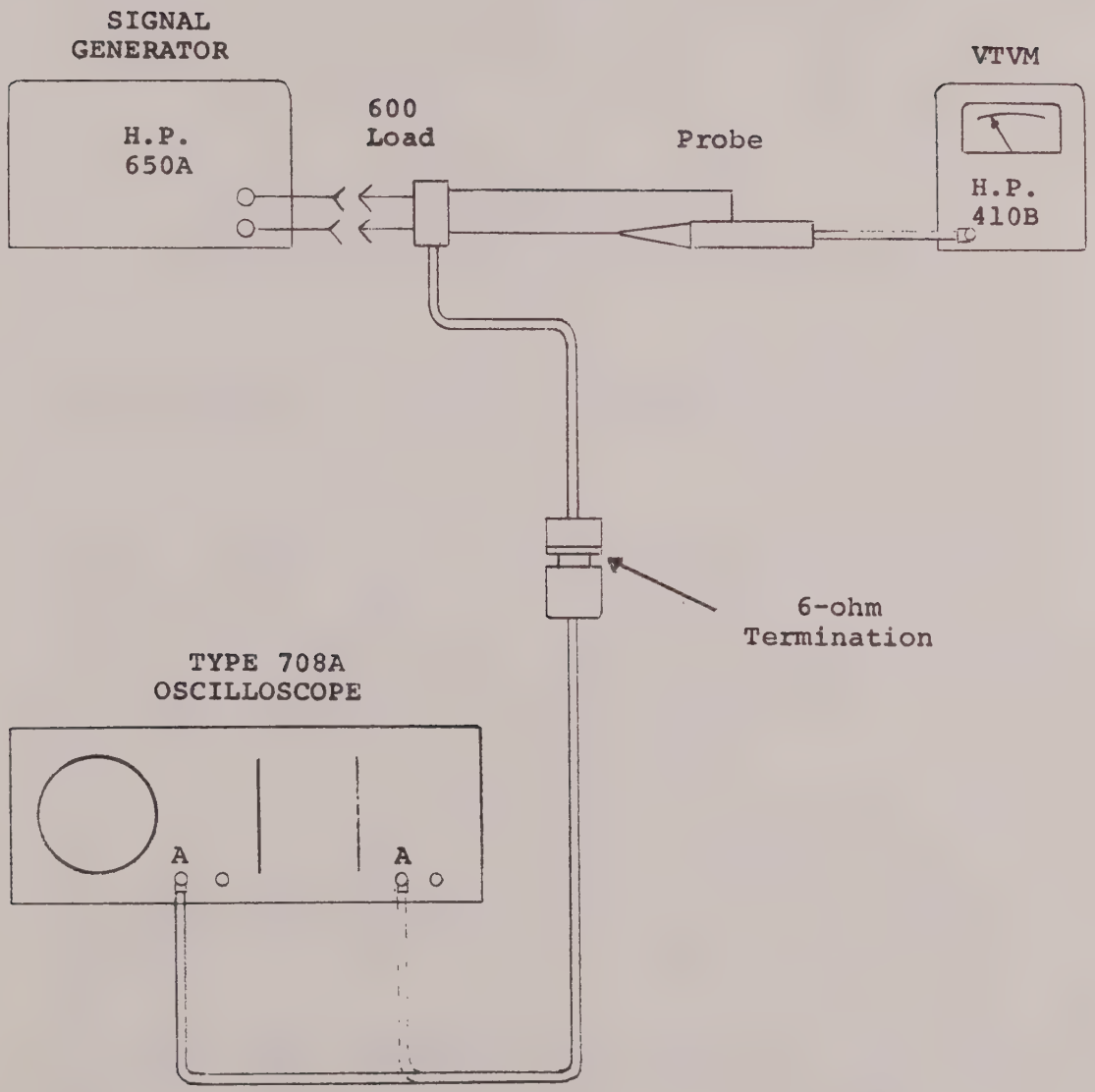


FIGURE 4-2. TEST SETUP FOR BANDWIDTH MEASUREMENT

SECTION 5

MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION (Figure 5-1)

Tnis section of the Instruction Manual contains service information and procedures for internal adjustments. Refer to Figure 5-1 for an over-all functional block diagram of the Type 708A Oscilloscope.

> **WARNING**
>
> WHEN THE COVERS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON

To gain access to the chassis for service, remove the top and bottom covers. This will expose all of the transistors, tubes and service adjustments for normal maintenance.

5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in the instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of Fairchild to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field representative maintains a limited number of spare parts. Also, the factory may be asked to air-ship replacement parts on a rush basis.

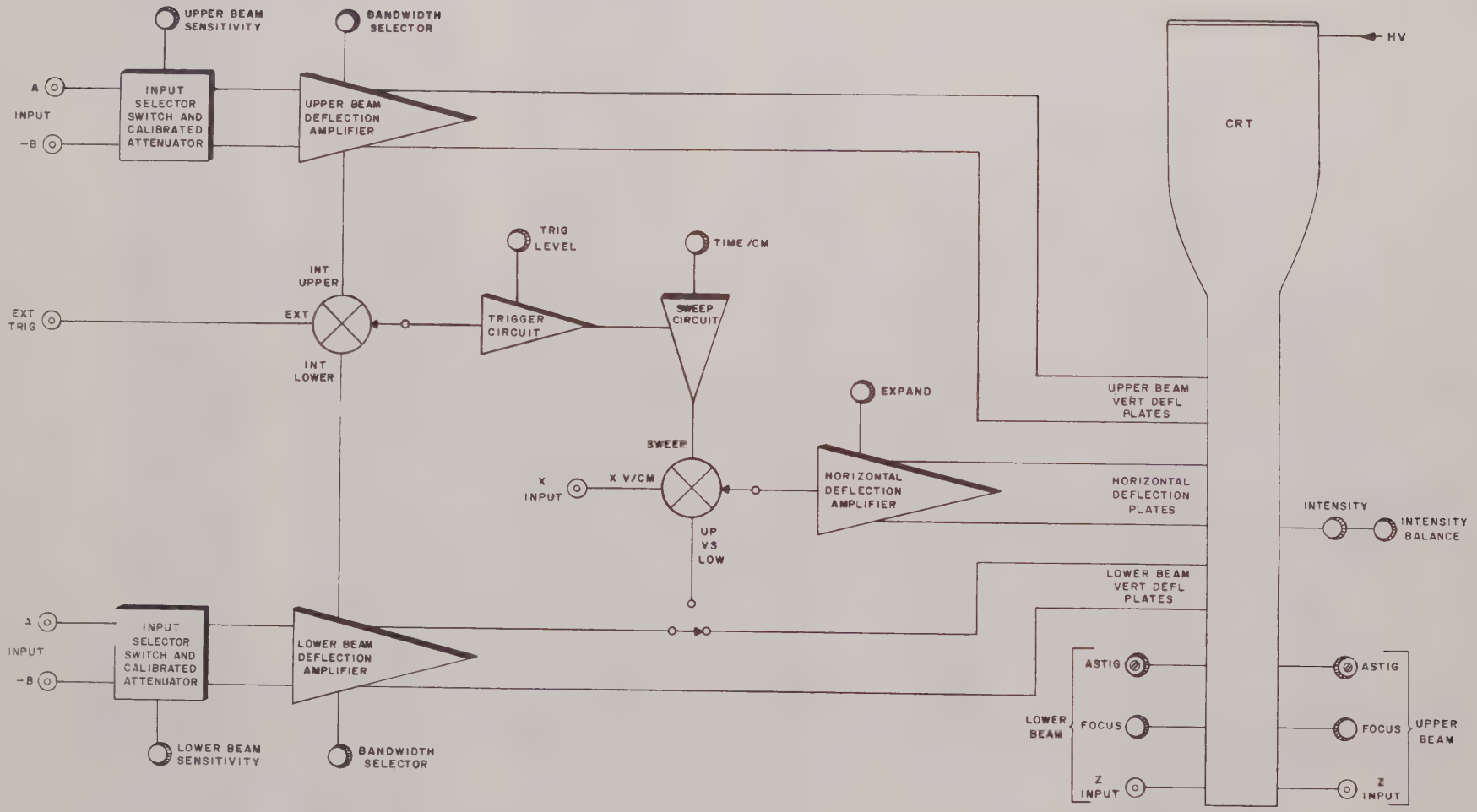


FIGURE 5-1. TYPE 708A OVERALL SYSTEM BLOCK DIAGRAM

The procedure for replacing most parts in this instrument is obvious, therefore specific instructions for their removal are not required.

NOTE: Be sure and replace the beryllium oxide insulating washers (they serve as heat sinks) on the transistors that require them. Always grease these heat sinks with Dow Corning silicon grease for optimum heat transfer.

5-3. CATHODE-RAY TUBE REPLACEMENT

> CAUTION
>
> THE CATHODE-RAY TUBE SHOULD BE HANDLED WITH GREAT CARE TO PREVENT BREAKAGE AND/OR SERIOUS PERSONAL INJURY FROM FLYING GLASS.

To remove the cathode-ray tube, first remove the top cover and disconnect the tube socket. Remove the bezel, the graticule, and loosen the tube clamp at the base of the CRT. Pull the cathode-ray tube straight out through the front panel. Install the new cathode-ray tube by reversing the order of removal. Before tightening the CRT clamp, energize the equipment and check that trace is parallel with horizontal center line of graticule. Refer to paragraph 5-7 for CRT external or internal graticule adjustments.

After the cathode-ray tube has been replaced it may be necessary to recalibrate. Special attention should be given to the amplifier sensitivities.

5-4. SERVICING HINTS

Although this is a complex electronic instrument, it may be localized to the following basic circuits:

1. Upper and Lower Beam Attenuator
2. Upper Beam Vertical Deflection Amplifier
3. Lower Beam Vertical Deflection Amplifier
4. Trigger and Sweep Circuits
5. Horizontal Deflection Amplifier
6. Low Voltage Power Supply
7. High Voltage Power Supply
8. Cathode-ray Tube Circuit

Whenever trouble occurs in this instrument, first try to localize it to one of these basic circuits.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble shooting this unit, refer to the system block diagram in this Section, and also to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate this instrument after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper equipment performance, the following suggestions are recommended:

1. If the instrument fails to operate, including the pilot light, check the source of power and determine that the power cord is firmly in place. Then check all fuses. A thermal cutout switch is incorporated in this unit. If the instrument has been working but has just stopped, it may have overheated and tripped the thermal cutout switch. The thermal cutout switch will reset itself when the interior temperature of the instrument drops to a safe value. Possible causes of overheating are restriction of air circulation and high ambient temperature.

2. If the line voltage is within the specified limits, and one of the regulated power supply output voltages is not correct, check that particular regulator circuit.

   NOTE: Always check the power supplies in the following order: -50V, +160V, +59V, -900V and 12.6V.

3. If there is nothing on the screen, try to set up the oscilloscope as depicted in Figure 2-8 entitled "Initial Setup of Type 708A Oscilloscope."

4. Localizing the trouble is made easier by use of an oscilloscope to check waveforms. Use a high-impedance probe while trouble shooting.

5. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks while soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

6. When using the accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the oscilloscope itself.

7. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by voltage measurements. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

8. Identification of electronic tubes, semiconductors and service adjustments are shown in photographs in this Section of the Instruction Manual.

5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. INTRODUCTION

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory.

Normally only periodic adjustment of the CAL and BALance controls will be necessary. The procedure outlined in this manual should be followed.

All adjustments should be made at mid-line voltage, 115V/230V ±2%.

WARNING

WHEN THE COVERS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON.
The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

b. TEST EQUIPMENT REQUIRED (Equivalent may be substituted)

Equipment	Description
Volt-ohmmeter	Simpson Model 260 20,000 ohms/volt sensitivity
Square Wave Generator	Fairchild Type 791A
Time Mark Generator	Fairchild Type 781A
Standard Amplitude Calibrator	Ballantine Type 420
High Voltage Meter	Sensitive Research Model DCH-1
Signal Generator	Hewlett-Packard Type 650A with 600-ohm termination
Autotransformer	Powerstat, Variac; capable of varying line voltage of the instrument over a range from 100 volts to 130 volts
AC Voltmeter	Weston Model 433
Precision DC Voltmeter	John Fluke Type 800
Oscilloscope	Fairchild Type 704
Micro Miker	Kay Lab, Model 402-B
VTVM	Hewlett Packard Type 410B
Alignment Tool	Insulated screwdriver (from Type 7013 Tool Kit)
4285A	50-ohm, 5-watt termination

5-6. ADJUSTING THE LV AND HV POWER SUPPLIED (R4008F/R & R4016)

Connect the autotransformer to a suitable power source and connect the oscilloscope output to this transformer. Turn on the instrument and set the output for the nominal operating voltage of the oscilloscope using the Weston Model 433 AC Voltmeter (115V for 115-volt operation, or 230V for 230-volt operation). Allow 30 to 60 minutes of warmup time before making any adjustments. Preset the front-panel X and Y controls as indicated.

Control	Setting
SENSITIVITY (both)	CAL (black)
Input Selector (both)	OFF
Time/cm	5 mSEC/CM
X DISPLAY	X1 NORM
TRIGGERING:	
SLOPE	+
NORMAL/SINGLE	NORMAL
TRIG SELECTOR	INT UPPER AC
TRIG LEVEL	AUTO (fully cw)

Use a John Fluke Voltmeter and adjust or check the supplies in the sequence listed.

> **CAUTION**
>
> Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in the oscilloscope may be damaged if over-voltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

1. Set the -50V ADJ potentiometer R6013F to the center of its range.

2. Adjust the +160V ADJ potentiometer R6013R for a meter reading of +160 volts.

3. Adjust the HV ADJ potentiometer R7017 for a meter reading of -900 volts at the cathode of CR7007.

> **WARNING**
>
> Dangerous high voltage. Use extreme care and safety leads when making this measurement.

4. Check the -12.6V supply. It should be within ±3%.

5-7. CRT ADJUSTMENTS

a. ASTIGMATISM (R7043 UPPER) (R7044 LOWER)

1. Set up the oscilloscope for normal operation using the calibration signal.

2. Adjust the UPPER ASTIG control simultaneously with the UPPER FOCUS control until optimized focusing of the pattern is obtained in both the horizontal and vertical plane. Repeat procedure using the LOWER ASTIG and FOCUS controls.

3. Maintain normal intensity while making these adjustments.

b. TRACE ALIGNMENT

To align the trace to the graticule, proceed as follows:

1. Set up the instrument for AUTOmatic sweep with no signal applied to the vertical channel.

2. Set the TRACE ALIGN screwdriver control in the center of its range.

3. Loosen CRT clamp.

4. Center the trace and rotate the CRT until the trace is parallel to the horizontal center line of the graticule.

5. Tighten CRT clamp.

5-8. PATTERN GEOMETRY ADJUSTMENT

When the PATTERN ADJ potentiometer is properly adjusted no part of the display shall fall outside a quality square boundry of 6 X 8 centimeters. To adjust pattern geometry proceed as follows:

1. Set the Upper and Lower Beam SENSITIVITY switches in the 20 mV/CM position, the sweep speed to 0.2 mSEC/CM and the X DISPLAY to X1 NORM.

2. Connect the output from a Hewlett-Packard Model 650A Generator to the A INPUT connectors on the Upper and Lower beam amplifiers.

3. Set the generator frequency to 500 KC and adjust its amplitude control for 6 centimeters of vertical deflection on screen.

4. Adjust the SWP LENGTH potentiometer R4141 for 8 centimeters horizontal deflection.

5. Adjust the PATTERN ADJ potentiometer R7046F for best square pattern within the 6 X 8 centimeter quality square.

6. After pattern adjustment is made reset the SWP LENGTH potentiometer for 10 centimeters of horizontal deflection.

5-9. DEFLECTION PLATE LEVEL ADJUSTMENTS

The X and Y DP LEVEL ADJ potentiometers are provided to set the X deflection plate average potential equal to the Y deflection plate average potentials.

1. Preset the following front-panel controls as indicated

Control	Setting
SENSITIVITY (both)	10 V/CM
PULL VARIABLE (both)	Pull Out & ccw
CAL 4CM Black (both)	ccw
X DISPLAY	X V/CM 1
TRIGGERING:	
SLOPE	+
TRIG SELECTOR	LINE
NORMAL/SINGLE	NORMAL

2. Temporarily short the collectors Q5005 and Q5006 together (located in the X amplifier).

3. Connect the John Fluke Voltmeter between the now common collectors to ground.

4. Adjust the horizontal DP LEVEL ADJ potentiometer R5036 for a meter reading of 105 volts. A range of 103V to 107V may be permitted to eliminate on-screen amplifier cutoff.

5. Disconnect the meter and the deflection plate short.

6. Temporarily short the collectors of Q1201 and Q1202 together (located in the upper beam Y amplifier).

7. Repeat steps 3 and 4 except adjust the vertical DP LEVEL ADJ potentiometer R1216 for 105 volts.

8. Disconnect the meter and the deflection plate short.

9. Temporarily short the collectors of Q2201 and Q2202 together. (located in the lower beam Y amplifier)

10. Repeat steps 3, 4 and 5 except adjust the vertical DP LEVEL ADJ potentiometer R2216 for 105 volts.

5-10. X AMPL DC BAL ADJUSTMENT

When the X AMPL DC BAL potentiometer R5006 is properly adjusted, there will be minimum depositioning of the trace when the X DISPLAY is switched from range to range. To adjust proceed as follows:

1. Set the X DISPLAY switch to the 1.0 V/CM position and center the trace on screen.

2. Adjust the X AMPL DC BAL potentiometer R5006 for minimum depositioning of the trace while switching the X DISPLAY switch back and forth throughout its range (1.0 V/CM to 0.02 V/CM).

5-11. X AMPL CAL ADJUSTMENT

1. Apply a 8-volt peak-to-peak signal from a Ballantine Type 420 Calibrator to the X INPUT connector.

2. Set X DISPLAY switch to 1.0 V/CM.

3. Adjust the X AMPL CAL potentiometer R5031 for 8 centimeters of horizontal deflection.

5-12. NORMALIZING UPPER AND LOWER AMPLIFIERS

The CAL 4CM front-panel screwdriver controls are employed to calibrate the amplifiers for a specific deflection. The CAL 4CM adjustments are color matched and should be used with the associated color sector of the SENSITIVITY switch. To properly normalize the gain of the instrument, proceed as follows:

1. Set the UPPER BEAM SENSITIVITY switch fully CCW to CAL (black) and the PULL VARIABLE control pushed in.

2. Set the BANDWIDTH KC selector switch to 5.

3. Adjust the CAL 4CM (black) screwdriver control for 4 centimeters of vertical deflection.

4. Set the UPPER BEAM SENSITIVITY switch fully cw to CAL (green).

5. Adjust the CAL 4CM (green) screwdriver control for 4 centimeters of vertical deflection.

6. Repeat steps 1 through 5 for the LOWER BEAM amplifier, using pertinent controls, settings and adjustments.

5-13. VERNIER AND ATTENUATOR BALANCE ADJUSTMENTS

When the VERN and ATTEN BAL controls are properly adjusted, there will be no depositioning of the trace when the SENSITIVITY and PULL VARIABLE controls are used. To adjust, proceed as follows:

1. Set the X DISPLAY switch in the SWEEP X1 NORM position.

2. Pull out the Upper and Lower Beam PULL VARIABLE controls and rotate them fully ccw to their minimum gain setting and set the SENSITIVITY controls to the 10 V/CM position.

3. Center the trace on screen using the POSITION controls.

   NOTE: It may be necessary to depress and hold the BEAM FINDER button and adjust the VERN BAL control to position the trace on screen.

4. Rotate the Upper Beam PULL VARIABLE clockwise to its maximum gain position observing the direction that the beam shifts vertically.

5. Adjust the front-panel VERN BAL control to bring the trace back to the center of the screen.

   NOTE: Do not change the setting of the POSITION controls.

6. Continue adjusting the front-panel VERN BAL control while rotating the Upper Beam PULL VARIABLE back and forth until there is no depositioning of the trace when the PULL VARIABLE control is rotated throughout its range.

7. Set the FINE ATTEN BAL control (outer knurled knob) to the center of its range.

8. Adjust the COARSE ATTEN BAL control (inner knurled knob) until there is no depositioning of the trace while switching the SENSITIVITY control back and forth between the 10 V/CM and the OFF position.

   NOTE: The VERN and ATTEN BALance controls are interdependent and must be repeated several times for optimum balance adjustment.

9. Repeat these balance adjustments for the LOWER BEAM amplifier using pertinent controls, settings and adjustments.

5-14. PHASE SHIFT ADJUSTMENT

A phase shift trimmer capacitor C1208 is added across the output of the vertical deflection amplifier and is adjusted when necessary for optimum phase differential between the X and Y amplifiers in a particular application. Normally this trimmer is set to minimum and does not require recalibration since its adjustment applies only to the X-Y comparison measurement on display.

If phase shift adjustment is required for certification, proceed as follows:

1. Apply a 100 KC sine wave signal from a properly terminated oscillator to the A INPUT connector of the Upper and Lower Beam amplifiers.

2. Set the Upper and Lower SENSITIVITY controls in the 10 mV/CM position and push in the associated PULL VARIABLE control.

3. Set the X DISPLAY switch in the UP vs LOW position.

4. Adjust sine wave generator for 8 centimeters of deflection.

5. Adjust trimmer capacitor C1208 for zero phase shift, a single diagonal line.

6. Reset the oscillator to 150 KC and adjust its output to give 8 centimeters of deflection on screen.

7. Observe phase shift. It should be no greater than 2 degrees.

   NOTE: Two (2) degrees of phase shift will be less than 0.3 centimeters of split at the center of the graticule.

5-15. ATTENUATOR ALIGNMENT

The attenuators are factory aligned and should not be touched unless there is positive indication that they require adjustment. If adjustment is necessary, follow the steps as outlined. The number shown in ( ) pertains to the Lower Beam amplifier adjustments.

1. Preset the following Upper Beam Amplifier controls as indicated:

Control	Setting
Input Selector	A, AC Sector
Trigger Selector	INT UPPER AC
SENSITIVITY	0.2 V/CM

2. Connect the output from a Fairchild Type 791A Square Wave Generator to the A INPUT connector of the Upper Beam amplifier.

3. Set the SOURCE **IMPEDANCE** switch, on the Type 791A to 50-ohms and the FREQUENCY control to 25 KC.

4. Adjust the output of the generator to give 4 centimeters of vertical deflection.

5. Adjust attenuator trimmer capacitor C1009 (C2009) for best square wave response.

6. Set the SENSITIVITY switch to 20 mV/CM and the generator frequency to 2.5 KC.

7. Adjust trimmer C1011 (C2011) for best flat top.

8. Disconnect the generator from A INPUT connector and connect it to the -B INPUT connector.

9. Set the Input Selector switch to -B AC sector and the SENSITIVITY control to 0.2 V/CM.

10. Set the generator frequency to 25 KC and adjust trimmer C1014 (C2014) for best flat bottom.

11. Set the SENSITIVITY switch to 20 mV/CM and the generator frequency to 2.5 KC.

12. Adjust trimmer C1016 (C2016) for best flat bottom.

13. Repeat the attenuator alignment for the Lower Beam amplifier using pertinent controls, settings and the adjustments shown in ( ).

    NOTE: A tabulation check of all ranges of the attenuator is shown in the Amplitude Check Calibration Chart located in Section 4 of this Instruction Manual.

5-16. INPUT CAPACITANCE ADJUSTMENT

The procedure for adjusting the input capacity for the Upper and Lower beam amplifiers is identical. Proceed as follows to adjust the input capacity for the Upper Beam amplifier. The numbers shown in ( ) pertain to the Lower Beam amplifier adjustments.

1. Set the SENSITIVITY switch to 0.2 V/CM and the Input Selector to A, AC sector.

2. Connect a Micro-Miker to the A INPUT connector and check the input capacity. It should be 50 pf, $\pm$3 pf.

3. Set the SENSITIVITY switch in the 10 mV/CM position and adjust trimmer capacitor C1101 (C1201) for the same capacity obtained in step 2.

4. Check the input capacity at each setting of the SENSITIVITY switch from the 10 V/CM to the 10 mV/CM position. The readings should be within ±2 pf of the capacity obtained in step 2.

5. Set the Input Selector switch to -B, AC sector and the SENSITIVITY switch in the 0.2 V/CM position.

6. Disconnect the Micro-Miker from the A INPUT and connect it to the -B INPUT connector.

7. Check the input capacity. It should be within ±2 pf or A INPUT reading.

8. Set the SENSITIVITY switch in the 10 mV/CM position and adjust trimmer capacitor C1102 (C2102) for the same input capacity obtained in Step 4.

9. Check the input capacity at each setting of the SENSITIVITY switch from the 10 V/CM to the 10 mV/CM position.

10. Repeat procedure for the Lower Beam amplifier using pertinent settings and the adjustments shown in ( ).

5-17. SWEEP ADJUSTMENTS

a. SWEEP LENGTH ADJUSTMENT

The SWP LENGTH potentiometer is provided so that the trace may be adjusted to display a horizontal scan of 10 to 11.5 centimeters when oscilloscope is set up for calibrated unexpanded sweep.

1. Set up the oscilloscope to obtain a normal calibrator display on the screen.

2. Adjust SWP LENGTH potentiometer R4141 until the display occupies 10.2 CM of horizontal deflection.

b. SWEEP CAL ADJUSTMENT

The SWP CAL front-panel screwdriver control is provided to standardize accurately the steps of the sweep speed switch. To adjust proceed as follows:

1. Set the X DISPLAY switch in the SWEEP X1 NORM position, the sweep speed to 5 mSEC/CM and push in the PULL VARIABLE control.

2. Apply a 5 millisecond output from a Fairchild Type 781A Time Mark Generator to the Upper Beam A INPUT connector and adjust the front-panel SWP CAL screwdriver control for one pulse per centimeter.

3. Set the sweep speed in the 5 mSEC/CM position and reset the generator for a 5 millisecond output.

4. Adjust trimmer capacitor C4201 for one pulse/centimeter.

c. SWEEP EXPANSION BAL ADJUSTMENT

When the SWP EXP BAL potentiometer is properly asjusted, there will be no off-screen displacement of the trace when the oscilloscope is switched from range to range of the Sweep Amplifier. To adjust, proceed as follows:

1. Set the sweep speed switch in the 5 mSEC/CM position and the generator for 5 millisecond output markers.

2. Position the display to the center of the screen setting a pulse at the center of the graticule.

3. Adjust the SWP EXT BAL potentiometer R5002 for minimum depositioning of the pulse about the graticule center while rotating the X DISPLAY switch back and forth between the X1 and X50 positions.

   NOTE: The sweep EXPAND lamp is out when the X DISPLAY switch is in the X1 position and on in the X2 thru X50 positions.

d. UP VS LOW CAL ADJUSTMENT

The UP vs LOW position of the X DISPLAY is used when it is desired to use the instrument for X-Y plotting. When the UP vs LOW CAL potentiometer is properly adjusted the gain of the Upper & Lower Beam amplifiers will be normalized. To adjust proceed as follows:

1. Preset the following controls as indicated

Control	Setting
X DISPLAY	UP vs LOW
SENSITIVITY (lower)	1 V/CM
PULL VARIABLE	CAL (pushed in)
Input Selector	A, AC Sector

2. Connect the output of a Ballantine Calibrator to the A INPUT connector of the Lower Beam amplifier.

3. Set the generator for an 8-volt peak-to-peak output and adjust the UP vs LOW CAL potentiometer for eight (8) centimeters of horizontal deflection.

e. STABILITY ADJUSTMENT

When the STAB control is properly adjusted the sweep will be free-running when the TRIG LEVEL control is set in the recurrent mode. To adjust proceed as follows:

1. Set the oscilloscope controls to obtain a CAL signal on screen.

2. Set the TRIG LEVEL control to RECUR and adjust the front-panel STAB control slowly until the trace disappears.

3. Readjust the STAB control to a point slightly past where the trace begins to fa

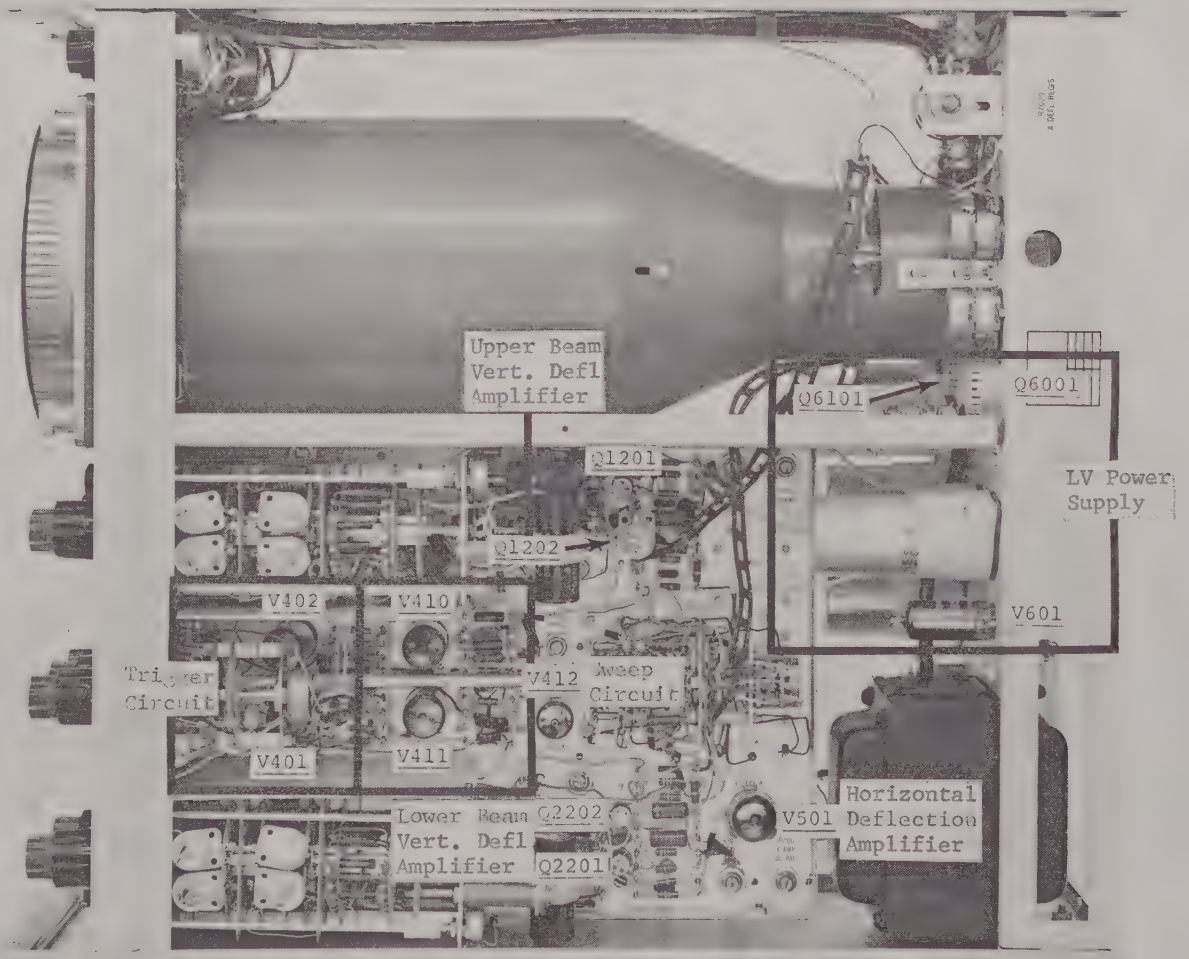


FIGURE 5-2. TOP VIEW SHOWING TUBE AND TRANSISTORS

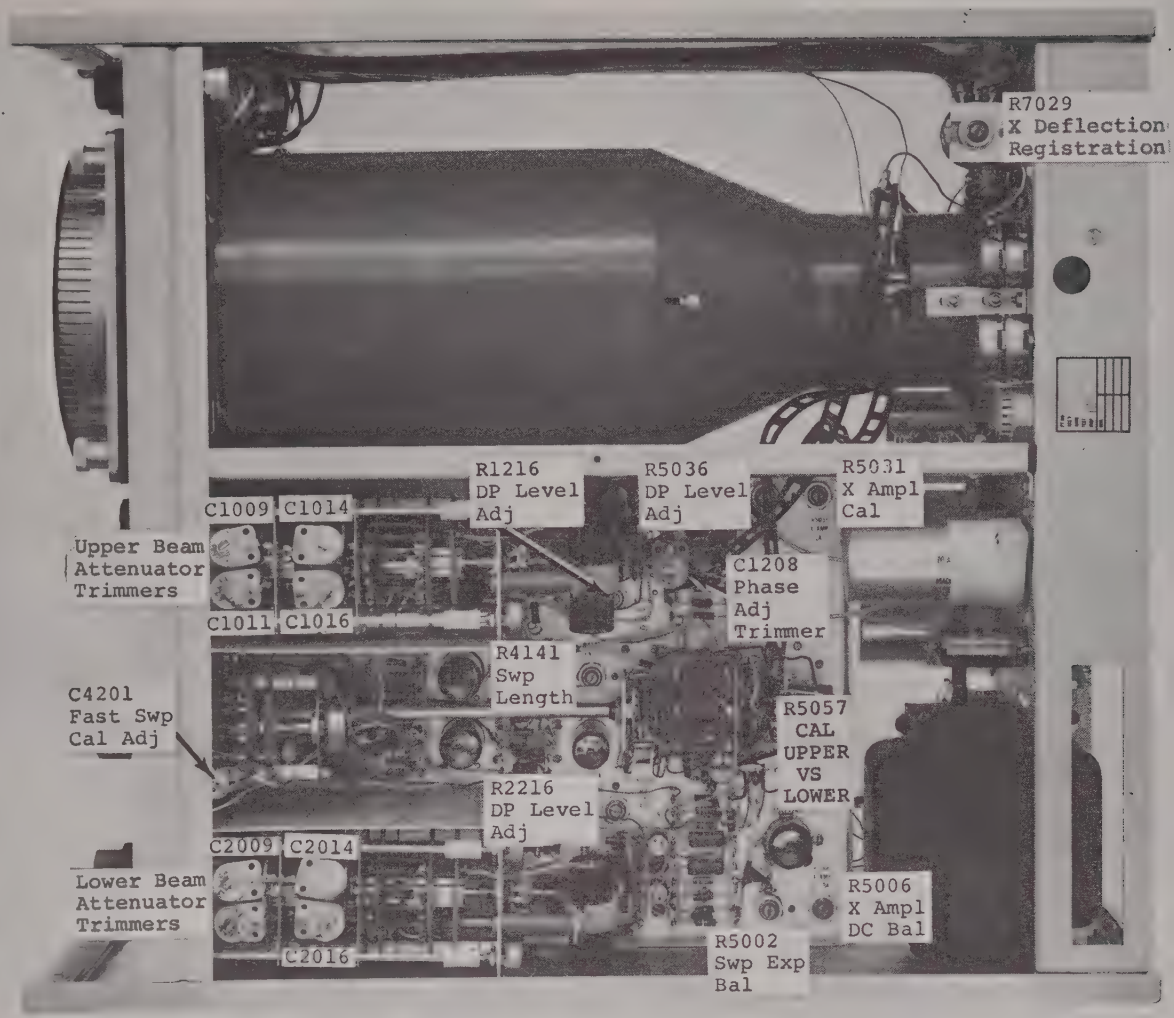


FIGURE 5-3. TOP VIEW SHOWING POT AND TRIMMER ADJUSTMENTS.

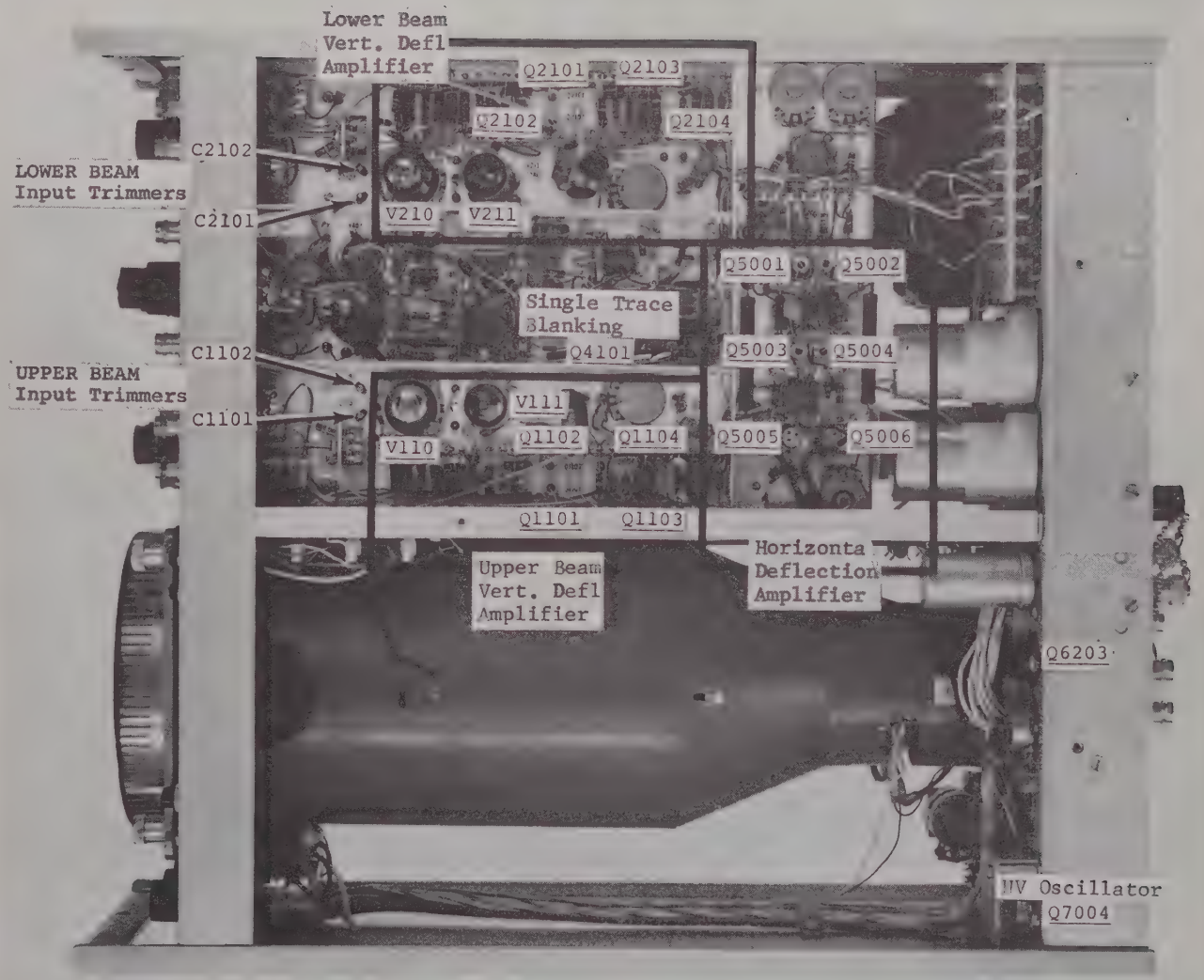


FIGURE 5-4. BOTTOM VIEW SHOWING TUBES, TRANSISTORS AND TRIMMER ADJUSTMENTS

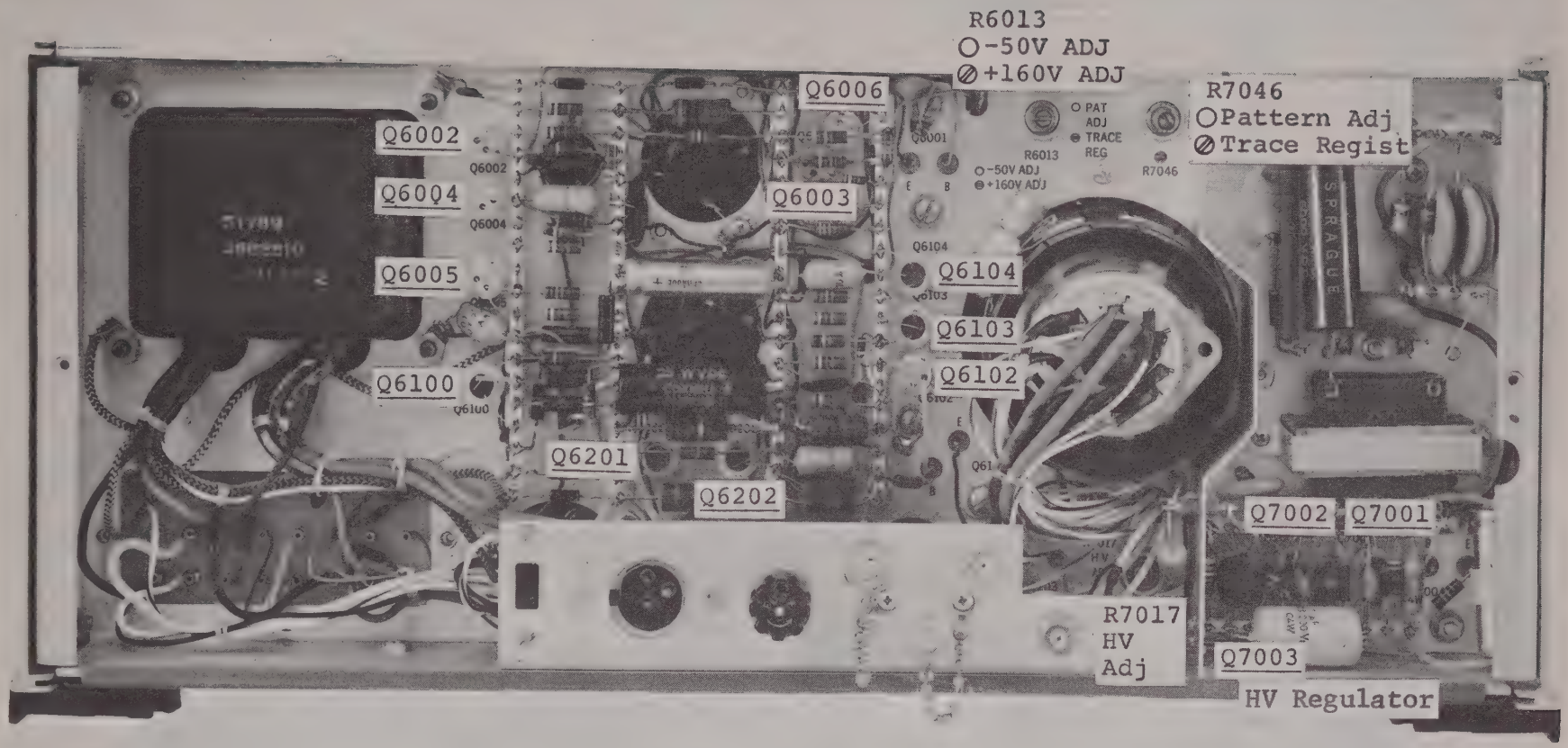


FIGURE 5-5. REAR VIEW SHOWING LV & HV POWER SUPPLY TRANSISTORS AND ADJUSTMENTS

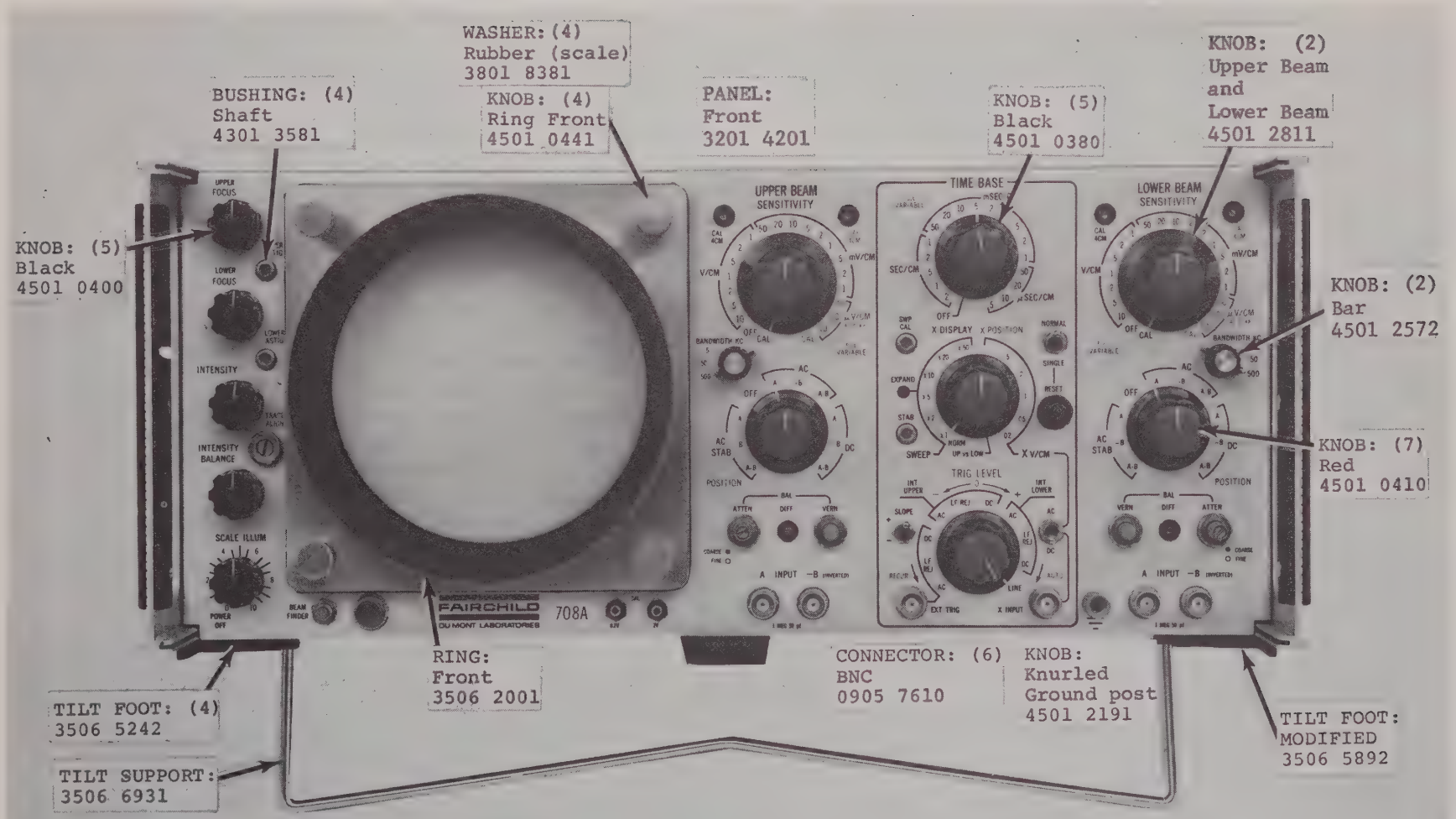


FIGURE 6-1. FRONT PANEL REPLACEABLE PARTS

SECTION 6A

ELECTRICAL PARTS LIST AND SCHEMATICS

TYPE 708A DUAL BEAM OSCILLOSCOPE

Symbol	Part Number	Description	Recommended Vendor Code	Type
		CAPACITORS		
Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.				
		2. GMV denotes Guaranteed Minimum Value.		
C1001	0327 3720*	plastic, 0.082 uf, ±20%, 600V	GEP	
C1002	0317 6240	mica, 7.5 pf, ±5%	EMC	DM20
C1003	0327 3720	plastic, 0.082 uf, ±20%, 600V	GEP	
C1004	0318 7040	1.8 pf, ±0.25 pf,	ERC	NPO331
C1006 & C1007	0313 4290	21 pf, ±0.5 pf,	ERC	GP1K
C1008	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C1009	0326 8650	variable, 4-30 pf,	ERC	TS2A
C1011	0326 8650	variable, 4-30 pf,	ERC	TS2A
C1012 & C1013	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C1014	0326 8650	variable, 4-30 pf,	ERC	TS2A
C1016	0326 8650	variable, 4-30 pf	ERC	TS2A
C1017	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C1018	0318 7040	1.8 pf, ±0.25 pf	ERC	NPO331
C1019	0327 1710	electrolytic, 500 uf, +150% -10%, 6V	CD	BR
C1021	0315 6990	10 pf, ±1 pf, 1000V	RMC	C
C1101	0319 1264	variable, plastic, 0.65-3.2 pf,300V	ABD	
C1102	0319 1266	variable, plastic, 0.65-3.2 pf,300V	ABD	
C1103	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM
C1106	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM
C1107 & C1108	0315 6990	10 pf, ±1 pf, 1000V	RMC	C
C1109	0326 4640	0.01 uf, GMV	ERC	811
C1111 & C1112	0316 7230	6.2 pf, ±0.25 pf	ERC	NPO331

*C1001 MUST BE MATCHED WITHIN 1% OF C1003

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		CAPACITORS (continued)		
C1113	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C1114	0327 1710	electrolytic, 500 uf, +150% -10%, 6V	CD	BR
C1116	0326 4640	0.01 uf, GMV	ERC	811
C1117	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C1118	0317 6720	mica, 750 pf, ±5%	EMC	DM20
C1119	0303 3380	mica, 6800 pf, ±5%, 300V	EIA	
C1201 & C1202	0316 7220	5.6 pf, ±0.25 pf	ERC	NPO331
C1203	0317 6660	mica, 430 pf, ±5%	EMC	DM20
C1204	0326 4640	0.01 pf, GMV	ERC	811
C1205	0317 6240	mica, 7.5 pf, ±5%	EMC	DM20
C1206	0326 4640	0.01 pf, GMV	ERC	811
C1207	0317 5070	mica, 12 pf, ±5%	EMC	DM15
C1208	0326 8650	variable, 4-30 pf	ERC	TS2A
C2001	0327 3720**	plastic, 0.082 uf, ±20%, 600V	GEP	
C2002	0317 6240	mica, 7.5 pf, ±5%	EMC	DM20
C2003	0327 3720**	plastic, 0.082 uf, ±20%, 600V	GEP	
C2004	0318 7040	1.8 pf, ±0.25 pf	ERC	NPO331
C2006 & C2007	0313 4290	21 pf, ±0.5 pf	ERC	GP1K
C2008	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C2009	0326 8650	variable, 4-30 pf	ERC	TS2A
C2011	0326 8650	variable, 4-30 pf	ERC	TS2A
C2012 & C2013	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C2014	0326 8650	variable, 4-30 pf	ERC	TS2A
C2016	0326 8650	variable, 4-30 pf	ERC	TS2A
C2017	0313 6250	mica, 187 pf, ±2%, 300V	EMC	605
C2018	0318 7040	1.8 pf, ±0.25 pf	ERC	NPO331

** C2001 MUST BE MATCHED WITHIN 1% OF C2003

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE (Continued)

Symbol	Part Number	Description	Recommended Vendor Code	Type
		CAPACITORS (Continued)		
C2019	0327 1710	electrolytic, 500 uf, +150% -10%, 6V	CD	BR
C2021	0315 6990	10 pf, ±1 pf, 1000V	RMC	C
C2101 & C2102	0319 1266	variable, plastic, 0.65-3.2 pf, 300V	ABD	
C2103	0319 1060	0.01 uf, +60 -40%, 150V	CPC	DDM
C2106	0319 1060	0.01 uf, +60 -40%, 150V	CPC	DDM
C2107 & C2108	0315 6990	10 pf, ±1 pf, 1000V	RMC	C
C2109	0326 4640	0.01 uf, GMV	ERC	811
C2111 & C2112	0316 7230	6.2 pf, ±0.25 pf	ERC	NPO331
C2113	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C2114	0327 1710	electrolytic, 500 uf, +150% -10%, 6V	CD	BR
C2116	0326 4640	0.01 uf, GMV	ERC	811
C2117	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C2118	0317 6720	mica, 750 pf, ±5%	EMC	DM20
C2119	0303 3380	mica, 6800 pf, ±5%, 300V	EIA	
C2201 & C2202	0316 7220	5.6 pf, ±0.25 pf	ERC	NPO331
C2203	0317 6660	mica, 430 pf, ±5%	EMC	DM20
C2204	0326 4640	0.01 uf, GMV	ERC	811
C2206	0326 4640	0.01 uf, GMV	ERC	811
C2207	0317 5070	mica, 12 pf, ±5%	EMC	DM15
C2208 & C2209	0315 6990	10 pf, ±1%, 1000V	RMC	C
C4001	0326 4520	0.001 uf, GMV	ERC	831
C4002	0326 4550	0.002 uf, GMV	ERC	831
C4003	0315 2000	100 pf, ±20%	EIA	
C4004	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		CAPACITORS (Continued)		
C4006	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM
C4007	0319 5850	27 pf, ±5%	ERC	NPO332
C4008	0326 7840	plastic, 0.047 uf, ±10%, 200V	AMX	C296AB
C4009	0315 2970	39 pf, ±10%	ERC	GPSL331
C4101	0326 8060	plastic, 0.1 uf, ±10%, 400V	AMX	C296AC
C4102 & C4103	0305 5100	mica, 51 pf, ±5%,	EIA	
C4104	0326 4640	0.01 uf, GMV	ERC	811
C4106	0305 5450	mica, 32 pf, ±5%	EIA	
C4107 & C4108	0316 7470	47 pf, ±5%	ERC	
C4109	0317 6750	mica, 1000 pf, ±5%	EMC	DM20
C4111 & C4112	0317 6670	mica, 470 pf, ±5%	EMC	DM20
C4201	0326 8650	variable, 4-30 pf	ERC	TS2A
C4202	0314 2660	68 pf, ±5%	ERC	GP1331
C4203	0327 8270	plastic, 0.86 uf, ±1%, 100V	GUD	355B
C4204	0318 5370	mica, 8514 pf, ±1%	EMC	CM35D
C4206	0326 7930	plastic, 1 uf, ±10%, 200V	AMX	C296AB
C4207	0326 7800	plastic, 0.01 uf, ±10%, 200V	AMX	C296AB
C5001	0326 5710	plastic, 0.1 uf, ±20%, 600V	GUD	355F
C5002 to C5004	0319 1050	0.02 uf, +60% -40%, 150V	CPC	DDM
C5006	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C5007	0326 4660	0.02 uf, GMV	ERC	841
C5008	0319 1050	0.02 uf, 150V		
C5009	0319 1050	0.02 uf, 150V		
C6001	0319 3880	electrolytic, 300 uf, 250V	MAL	FP
C6002	0326 4520	1000 pf, GMV	ERC	831
C6004	0326 4640	0.01 uf, GMV	ERC	811

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE (Continued

Symbol	Part Number	Description	Recommended Vendor Code	Type
	CAPACITORS (Continued)			
C6006	0326 4640	0.01 uf, GMV	ERC	811
C6007	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6008	0326 4640	0.01 uf, GMV	ERC	811
C6009	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6011	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6012	0300 2440	electrolytic, 10 uf, +50 -10%, 450V	CDE	UP1045
C6013	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6101 & C6102	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM
C6103	0319 3890	electrolytic, 400 uf, -10% +100%, 150V	MAL	FP
C6104	0326 4520	1000 pf, GMV	ERC	831
C6106	0326 4640	0.01 uf, GMV	ERC	811
C6107	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6108	0326 7590	electrolytic, 12 uf, +100 -10%, 150V	SPG	30D219A1
C6201 & C6202	0327 6920	electrolytic, 1500 uf, -10% +100%, 50V	SPG	62D
C6203	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C6204	0327 8230	electrolytic, 100 uf, +250 -10%, 25V	MAL	TCW
C6206 & C6207	0319 1060	0.01 uf, +60% -40%, 150V	CPC	DDM
C7001	0319 1050	0.02 uf, +60% -40%, 150V	CPC	DDM
C7002	0326 7930	plastic, 1 uf, ±10%, 200V	CPC	DDM
C7003	0319 1050	0.02 uf, +60% -40%, 150V	CPC	DDM
C7004	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C7005	0319 4600	paper, 4700 pf, ±10%, 6000V	SPG	184P

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		CAPACITORS (Concluded)		
C7006	0326 7590	electrolytic, 12 uf, +100 -10%, 150V	SPG	30D219A1
C7007	0326 7820	plastic, 0.022 MFD, ±10%, 200V	AMX	C296AB
C7008	0316 9190	1000 pf, ±20%, 3000V	RMC	3KV
C7009 & C7010	0316 4930	0.01 uf, +100% -0%, 2000V	RMC	2KV
C7011 & C7012	0326 4640	0.01 uf, GMV	ERC	811
C7013 & C7014	0316 4930	0.01 uf, +100% -0%, 2000V	RMC	2KV
C7016	0316 4930	0.0I uf, +100% -0%, 2000V	RMC	2KV
C7017	0326 7760	470 pf, ±20%, 6000V	RMC	
C7018	0326 7860	plastic, 0.1 uf, ±10%, 200V	AMX	C296AB
C7019	0316 4930	0.01 uf, +100% -0%, 2000V	RMC	2KV
C7021	0316 4930	0.01 uf, +100% -0%, 2000V	RMC	2KV
		SEMICONDUCTORS		
CR1201 & CR1202	2600 6910	diode, FD841		
CR1101 & CR1102	2600 8880	diode, zener, 1N753A	FCI	
CR2101 & CR2102	2600 8880	diode, zener, 1N753A	FCI	
CR2201 & CR2202	2600 6910	diode, FD841		
CR4100 to CR4102	2600 6910	diode, FD841	FCI	
CR4103	2600 8020	diode, FDG3091	FCI	
CR4104	2600 6820	diode, FD281	FCI	
CR4105 to CR4109	2600 6910	diode, FD841	FCI	
CR4111	2600 6910	diode, FD841	FCI	
CR5001	2600 9040	diode, 1N971B	FCI	
CR5002	2600 6910	diode, FD841	FCI	
CR6001 to CR6006	2600 9220	diode, silicon, 1N4384	GEN	
CR6007	2600 6910	diode, FD841	FCI	
CR6101 to CR6104	2600 9220	diode, silicon, 1N4384	GEN	
CR6201 & CR6202	2600 9220	diode, silicon, 1N4384	GEN	

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE (Continued

Symbol	Part Number	Description	Recommended Vendor Code	Type
		SEMICONDUCTORS (Concluded)		
CR7000	2600 8020	diode, FDG 3091		
CR7001	2600 9220	diode, silicon, 1N4384	GEN	
CR7002	2600 9050	diode, 1N972B	FCI	
CR7003	2600 3011	rectifier, metallic	ABD	
CR7004 & CR7005	2600 3031	rectifier, metallic	ABD	
CR7006	2600 9020	diode, 1N969B	FCI	
CR7007	2600 6830	diode, ZT82A	ITT	
		LAMPS		
DS4101		PART OF S411 SWP READY		
DS5001	1200 3960	glow NE-2 (EXP SWP)	GE	
E4101	1200 3960	glow NE-2	GE	
DS6200	1201 2340*	lampholder	DRK	121-7
DS6201 & DS6202	1200 1310	incandescent, bayonet, #47	GE	
		FUSES		
F600	1100 0990	2 amperes, SLO-BLO	LFI	313002
F601	1100 0740	0.5 ampere	LFI	312,500
F610	1100 0740	0.5 ampere	LFI	312,500
F620	1100 0990	2 amperes, SLO-BLO	LFI	313002
		ELECTRICAL CONNECTORS		
J1001	0905 7610	receptacle, RF, BNC, female, 1 contact (UPPER INPUT A)	UG 625A/U	
J1002	0905 7610	receptacle, RF, BNC, female, 1 contact (UPPER INPUT-B)	UG 625A/U	
J1201	0905 7610	receptacle, RF, BNC, female, 1 contact	UG 625A/U	

*12010650, REPLACEMENT BULB

Symbol	Part Number	Description	Recommended Vendor Code	Type
		ELECTRICAL CONNECTORS (Concluded)		
J2001	0905 7610	receptacle, RF, BNC, female, 1 contact (LOWER INPUT A)	UG 625A/U	
J2002	0905 7610	receptacle, RF, BNC, female, 1 contact (LOWER INPUT-B)	UG 625A/U	
J4001	0905 7610	receptacle, RF, BNC, female, 1 contact (EXT TRIG)	UG 625A/U	
J4101	0905 7610	receptacle, RF, BNC, female, 1 contact (EXT RESET)	UG 625A/U	
J4102	0905 7610	receptacle, RF, BNC, female, 1 contact	UG 625A/U	
J5001	0905 7610	receptacle, RF, BNC, female, 1 contact (X INPUT)	UG 625A/U	
J6001	0904 4234	receptacle AC modified	ABD	
J7001	0905 7610	receptacle, RF, BNC, female, 1 contact (UPPER Z INPUT)	UG 625A/U	
J7002	0905 7610	receptacle, RF, BNC, female 1 contact (LOWER Z INPUT)	UG 625A/U	
J6100	0904 4381	jack tip black (2 V CAL)	ABD	
J6101	0904 4381	jack tip black (0.2 V CAL)	ABD	
P7001	0905 9150	cover, elec, BNC	DAG	2096
P7002	0905 9150	cover, elec, BNC	DAG	2096

Symbol	Part Number	Description	Recommended Vendor Code	Type
		TRANSISTORS		
Q1101 & Q1102	2600 7420 2600 7400	DU #9A alternate, 2N869	FCI	
Q1103 & Q1104	2600 7070 2600 7050	DU #2A alternate, 2N915	FCI	
Q1201 & Q1202	2600 7270 2600 7250	DU #6A alternate, 2N1893	FCI	
Q2101 & Q2102	2600 7420 2600 7400	DU #9A alternate, 2N869	FCI	
Q2103 & Q2104	2600 7070 2600 7050	DU #2A alternate, 2N915	FCI	
Q2201 & Q2202	2600 7270 2600 7250	DU #6A alternate, 2N1893	FCI	
Q4101	2600 7270 2600 7250	DU #6A alternate, 2N1893	FCI	
Q5001 to Q5004	2600 7060 2600 7050	DU #2 alternate, 2N915	FCI	
Q5005 & Q5006	2600 8640 2600 8620	DU #36A alternate, 2N3114	FCI	
Q6001	2600 9170 2600 9150	DU #51A alternate, 2N3442	RCA	
Q6002	2600 8630 2600 8620	DU #36 alternate, 2N3114	FCI	
Q6003 to Q6005	2600 7260 2600 7250	DU #6 alternate, 2N1893	FCI	
Q6006	2600 7270 2600 7250	DU #6A alternate, 2N1893	FCI	

Symbol	Part Number	Description	Recommended Vendor Code	Type
	TRANSISTORS (Concluded)			
Q6100	2600 7210 2600 7200	DU #5 alternate, 2N1420	FCI	
Q6101	2600 9170 2600 9150	DU #51A alternate, 2N3442	RCA	
Q6102	2600 7260 2600 7250	DU #6 alternate, 2N1893	FCI	
Q6103 & Q6104	2600 7460 2600 7450	DU #10 alternate, 2N1711	FCI	
Q6201	2631 2100 2631 2070	DU #54B alternate, 2N3503	TEX	
Q6202	2600 7230 2600 7200	DU #5B alternate, 2N1420	FCI	
Q6203	2600 7820 2600 8030	2N1529 alternate, 2N511	MOT	
Q7001	2600 7460 2600 7450	DU #10 alternate, 2N1711	FCI	
Q7002 & Q7003	2600 9200	2N3390	GE	
Q7004	2600 9170 2600 9150	DU #51A alternate, 2N3442	RCA	
L7001	2101 8441	coil trace alignment	ABD	

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS		
Note: All resistors are fixed, film, ±5%, 1/2W, and values in ohms unless otherwise specified; K = thousand, M = million				
R1001 & R1002	0229 4700	1M, ±1%	TEX	CD1/2PR
R1003	0229 9170	1K, ±1%	TEX	CD1/2PR
R1004	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R1006	0204 1440	composition, 10M	IRC	GBT
R1007	0229 9050	111K, ±1%	TEX	CD1/2PR
R1008	0229 9170	1K, ±1%	TEX	CD1/2PR
R1009	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R1011	0204 1440	composition, 10M	IRC	GBT
R1012	0229 9050	111K, ±1%	TEX	CP1/2PR
R1013	0236 4960	178, ±1%	CGW	NS20
R1014	0236 6420	5.9K, ±1%	CGW	NS20
R1016	0236 9000	2.25K, ±1%	CGW	NS20
R1017	0236 8980	990, ±1%	CGW	NS20
R1018	0236 5270	374, ±1%	CGW	NS20
R1019	0236 8970	18.1K, ±1%	CGW	NS20
R1101	0235 6210	composition, 100K, ±10%, 1/4W	ALB	CB
R1102	0203 1010	composition, 160K	ALB	EB
R1103	0203 0540	composition, 1.8K	ALB	EB
R1104	0235 6210	composition, 100K, ±10%, 1/4W	ALB	CB
R1105	0235 5970	composition, 1K, ±10%, 1/4W	ALB	CB
R1106	0203 1130	composition, 510K	ALB	EB
R1107	0106 7820	variable, composition, 1M, ±20% 1/5W (DIFF BAL)	CTS	70
R1108	0203 1130	composition, 510K	ALB	EB
R1109	0235 5970	composition, 1K, ±10%, 1/4W	ALB	CB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R1111 & R1112	0236 6900	18.7K, ±1%	CGW	NS20
R1113 & R1114	0236 7740	140K, ±1%	CGW	NS20
R1116	0109 1700	variable, wirewound, 10K/10K, ±10%, 4W (ATTEN BAL)	CTS	C2-AW
R1117 & R1118	0234 9450	47K, 1W	CGW	C32
R1119	0236 7770	150K, ±1%	CGW	NS20
R1121	0236 7770	150K, ±1%	CGW	NS20
R1122	0236 7620	105K, ±1%	CGW	NS20
R1123	0109 1730	variable, wirewound, 5K, ±10% 4W (VERN BAL)	CTS	AW
R1124	0236 7620	105K, ±1%	CGW	NS20
R1126	0235 5850	composition, 100, ±10%, 1/4W	ALB	CB
R1127	0203 1610	composition, 47, ±10%	ALB	EB
R1128	0203 1650	composition, 100, ±10%	ALB	EB
R1129	0234 9270	8.2K, 1W	CGW	C32
R1131	0234 9270	8.2K, 1W	CGW	C32
R1132 & R1133	0236 6930	20K, ±1%	CGW	NS20
R1134	0203 1610	composition, 47, ±10%	ALB	EB
R1136	0109 3320	variable, composition, 500, ±10%, 3/10W (CAL X1)	CTS	70
R1137	0107 2366	variable composition, 2.5K, ±20% (PART OF S110) VARIABLE		
R1138	0203 0340	composition, 270	ALB	EB
R1139	0203 0170	composition, 51	ALB	EB
R1141	0203 1530	composition, 10, ±10%	ALB	EB
R1142	0109 3320	variable, composition, 500, ±10% 3/10W (CAL X0.1)	CTS	70
R1143 & R1144	0203 1650	composition, 100, ±10%	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R1146 & R1147	0234 9400	30K, 1W	CGW	C32
R1148	0203 1580	composition, 27, ±10%	ALB	EB
R1149	0234 8300	2.4K	CGW	C20
R1151	0234 8300	2.4K	CGW	C20
R1152	0234 9350	18K, 1W	CGW	C32
R1153	0234 9350	18K, 1W	CGW	C32
R1201	0203 0670	composition, 6.2K	ALB	EB
R1202	0203 0860	composition, 39K	ALB	EB
R1203	0109 3270	variable, composition, 50K/50K ±20%, 1W (POSITION)	CTS	2-90
R1204	0203 0860	composition, 39K	ALB	EB
R1206 & R1207	0203 1650	composition, 100, ±10%	ALB	EB
R1208	0203 0900	composition, 56K	ALB	EB
R1211	0203 0420	composition, 560	ALB	EB
R1212	0203 0380	composition, 390	ALB	EB
R1213 & R1214	0237 1120	16K, 2W	CGW	C42S
R1216	0108 4680	variable, composition, 5K, ±20%, 1W (DP LEVEL ADJ)	CTS	90CV
R1217	0203 1580	composition, 27, ±10%	ALB	EB
R1218	0203 0820	composition, 27K	ALB	EB
R1219	0203 1580	composition, 27, ±10%	ALB	EB
R1221 & R1222	0236 9790	7.5K, ±2%, 2W	CGW	C42S
R1223	0203 1220	composition, 1.2M	ALB	EB
R1224	0203 1140	composition, 560K	ALB	EB
R1226	0234 8540	24K,	CGW	C20
R1227	0234 8410	6.8K	CGW	C20
R1228	0234 8620	51K	CGW	C20

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R2001 & R2002	0229 4700	1M, ±1%	TEX	CD1/2PR
R2003	0229 9170	1K, ±1%	TEX	CD1/2PR
R2004	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R2006	0204 1440	composition, 10M,	IRC	GBT
R2007	0229 9050	111K, ±1%	TEX	CD1/2PR
R2008	0229 9170	1K, ±1%	TEX	CD1/2PR
R2009	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R2011	0204 1440	composition, 10M	IRC	GBT
R2012	0229 9050	111K, ±1%	TEX	CD1/2PR
R2013	0236 4960	178, ±1%	CGW	NS20
R2014	0236 6420	5.9K, ±1%	CGW	NS20
R2016	0236 9000	2.25K, ±1%	CGW	NS20
R2017	0236 8980	990, ±1%	CGW	NS20
R2018	0236 5270	374, ±1%	CGW	NS20
R2019	0236 8970	18.1K, ±1%	CGW	NS20
R2101	0235 6210	composition, 100K, ±10%, 1/4W	ALB	CB
R2102	0203 1010	composition, 160K	ALB	EB
R2103	0203 0540	composition, 1.8K,	ALB	EB
R2104	0235 6210	composition, 100K, ±10%, 1/4W	ALB	CB
R2105	0235 5970	composition, 1K, ±10%, 1/4W	ALB	CB
R2106	0203 1130	composition, 510K	ALB	EB
R2107	0106 7820	variable, composition, 1M, 1/5W (DIFF BAL)	CTS	70
R2108	0203 1130	composition, 510K	ALB	EB
R2109	0235 5970	composition, 1K, ±10%, 1/4W	ALB	CB
R2111 & R2112	0236 6900	18.7K, ±1%	CGW	NS20
R2113 & R2114	0236 7740	140K, ±1%	CGW	NS20

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R2116	0109 1700	variable, wirewound, 10K/10K ±10%, 4W (ATTEN BAL)	CTS	C2-AW
R2117	0234 9450	47K, 1W	CGW	C32
R2118	0234 9450	47K, 1W	CGW	C32
R2119	0236 7770	150K, ±1%	CGW	NS20
R2121	0236 7770	150K, ±1%	CGW	NS20
R2122	0236 7620	105K, ±1%	CGW	NS20
R2123	0109 1730	variable, wirewound, 5K, ±10%, 4W (VERN BAL)	CTS	AW
R2124	0236 7620	105K, ±1%	CGW	NS20
R2126	0203 1650	composition, 100, ±10%	ALB	EB
R2127	0203 1610	composition 47, ±10%	ALB	EB
R2128	0235 5850	composition, 100, ±10%, 1/4W	ALB	CB
R2129	0234 9270	8.2K, 1W	CGW	C32
R2131	0234 9270	8.2K, 1W	CGW	C32
R2132 & R2133	0236 6930	20K, ±1%	CGW	NS20
R2134	0203 1610	composition, 47, ±10%	ALB	EB
R2136	0109 3320	variable, composition, 500, ±10%, 3/10W (CAL X1)	CTS	70
R2137	0107 2366	variable, composition, 2.5K, ±20% (PART OF •S210) VERNIER	CTS	70
R2138	0203 0340	composition, 270	ALB	EB
R2139	0203 0170	composition, 51	ALB	EB
R2141	0203 1530	composition, 10, ±10%	ALB	EB
R2142	0109 3320	variable, composition, 500, ±10% 3/10W (CAL XO.1)	CTS	70
R2143 & R2144	0203 1650	composition, 100, ±10%	ALB	EB
R2146 & R2147	0234 9400	30K, 1W	CGW	C32
R2148	0203 1580	composition, 27, ±10%	ALB	EB

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R2149	0234 8300	2.4K,	CGW	C20
R2151	0234 8300	2.4K	CGW	C20
R2152 & R2153	0234 9350	18K, 1W	CGW	C32
R2201	0203 0670	composition, 6.2K	ALB	EB
R2202	0203 0860	composition, 39K	ALB	EB
R2203	0109 3270	variable, composition, 50K/50K, ±20%, 1W (POSITION)	CTS	2-90
R2204	0203 0880	composition, 39K	ALB	EB
R2206 & R2207	0203 1650	composition, 100, ±10%	ALB	EB
R2211	0203 0420	composition, 560	ALB	EB
R2212	0203 0380	composition, 390	ALB	EB
R2213 & R2214	0237 1120	16K, 2W	CGW	C42S
R2216	0108 4680	variable, composition, 5K, ±20%, 1W (DP LEVEL ADJ)	CTS	90CV
R2217	0203 1580	composition, 27, ±10%	ALB	EB
R2219	0203 1580	composition, 27, ±10%	ALB	EB
R2221 & R2222	0236 9790	7.5K, ±2%, 2W	CGW	C42S
R2223	0203 1220	composition, 1.2M	ALB	EB
R2224	0203 1140	composition, 560K	ALB	EB
R2226 & R2227	0203 0890	composition, 51K	ALB	EB
R2228	0203 0810	composition, 24K	ALB	EB
R2229	0203 0680	composition, 6.8K	ALB	EB
R2231	0203 0810	composition, 24K	ALB	EB
R2232	0203 0680	composition, 6.8K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R4001	0203 1890	composition, 10K, ±10%	ALB	EB
R4002	0203 1200	composition, 1M	ALB	EB
R4003	0203 1040	composition, 220K	ALB	EB
R4004	0203 1000	composition, 150K	ALB	EB
R4005	0203 0960	composition, 100K	ALB	EB
R4006	0203 0930	composition, 75K	ALB	EB
R4007		variable, composition, 500K, 1/4W (PART OF S401A/B TRIG LEVEL)		
R4008	0203 0890	composition, 51K	ALB	EB
R4009	0234 8540	24K	CGW	C20
R4011	0235 5850	composition, 100, ±10%, 1/4W	ALB	CB
R4012	0203 0720	composition, 10K	ALB	EB
R4013	0203 1650	composition, 100, ±10%	ALB	EB
R4014	0234 9260	7.5K, 1W	CGW	C32
R4016	0203 0690	composition, 7.5K	ALB	EB
R4017	0234 9470	56K, 1W	CGW	C32
R4018	0234 8540	24K	CGW	C32
R4019	0234 9490	68K, 1W	CGW	C32
R4021 & R4022	0203 0880	composition, 47K	ALB	EB
R4023	0203 1650	composition, 100, ±10%	ALB	EB
R4024	0203 1270	composition, 2M	ALB	EB
R4026	0203 0540	composition, 1.8K	ALB	EB
R4027	0236 7740	140K, ±1%	CGW	NS20
R4028	0236 7770	150K, ±1%	CGW	NS20
R4029	0234 9350	18K, 1W	ALB	EB
R4031	0203 1650	composition, 100, ±10%	ALB	EB
R4032	0203 0600	composition, 3.3K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R4101	0235 5810	composition, 47, ±10%, 1/4W	ALB	CB
R4102	0203 0540	composition, 1.8K	ALB	EB
R4103	0237 1150	22K, 2W	CGW	C42S
R4104	0203 1650	composition, 100, ±10%	ALB	EB
R4106	0234 9440	43K, 1W	CGW	C32
R4107	0236 7440	68.1K, ±1%	CGW	NS20
R4108	0234 8580	36K	CGW	C20
R4109	0203 0940	composition, 82K	ALB	EB
R4111	0203 0890	composition, 51K	ALB	EB
R4112	0237 1180	30K, 2W	CGW	C42S
R4113	0203 0930	composition, 75K	ALB	EB
R4114	0203 1650	composition, 100, ±10%	ALB	EB
R4116	0203 0890	composition, 51K	ALB	EB
R4117	0203 0900	composition, 56K	ALB	EB
R4118	0203 1080	composition, 330K	ALB	EB
R4119	0203 0960	composition, 100K	ALB	EB
R4121	0235 4380	composition, 100,1/4W	ALB	EB
R4122	0234 9160	3K, 1W	CGW	C32
R4123 & R4124	0236 7210	39.2K, ±1%	CGW	NS20
R4126	0236 7750	143K, ±1%	CGW	NS20
R4127	0106 7810	variable, composition, 10K, ±20%, 3/10W (STAB ADJ)	CTS	70
R4128	0203 0790	composition, 20K	ALB	EB
R4129	0203 0480	composition, 1K	ALB	EB
R4131	0203 1000	composition, 150K	ALB	EB
R4132	0203 0550	composition, 2K	ALB	EB
R4133	0203 1040	composition, 220K	ALB	EB
R4134	0235 5210	composition, 330K, 1/4W	ALB	EB
R4135	0203 0660	composition, 5.6K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R4136	0203 1280	composition, 2.2M	ALB	EB
R4137	0203 0640	composition, 4.7K	ALB	EB
R4138	0203 1200	composition, 1M	ALB	EB
R4139	0204 1440	composition, 10M	IRC	GBT
R4141	0109 1310	variable, composition, 1.5K, 3/4S (SWP LENGTH)	CTS	45
R4142	0237 1010	5.6K, 2W	CGW	C42S
R4143 & R4144	0203 0930	composition, 75K	ALB	EB
R4145	0234 8390	5.6K	CGW	C20
R4146	0203 0930	composition, 75K	ALB	EB
R4147	0203 0720	composition, 10K	ALB	EB
R4148	0203 0960	composition, 100K	ALB	EB
R4149	0203 0890	composition, 51K	ALB	EB
R4151	0237 1180	30K, 2W	ALB	EB
R4152	0203 0480	composition, 1K	ALB	EB
R4201	0107 2361	variable, composition, 50K (PART OF S421, VARIABLE)		
R4202	0109 0480	variable, composition, 2.5K, ±20%, 3/10W (SWP CAL)	CTS	70
R4203	0203 0780	composition, 18K	ALB	EB
R4204	0234 2270	10M, ±1%	TEX	CD1/2SR
R4206 & R4207	0234 2270	10M, ±1%	TEX	CD1/2SR
R4208	0234 2260	6M, ±1%	TEX	CD1/2SR
R4209	0229 4680	2M, ±1%	TEX	CD1/2PR
R4211 & R4212	0229 4700	1M, ±1%	TEX	CD1/2PR
R5001	0229 4700	1M, ±1%	TEX	CD1/2PR
R5002	0109 1340	variable, composition, 100K, 1/4W (SWP EXP BAL)	CTS	45
R5003	0203 1000	composition, 150K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		RESISTORS (Continued)		
R5004	0203 0520	composition, 1.5K	ALB	EB
R5006	0109 1340	variable, composition, 100K, 1/4W (X AMP DC BAL)	CTS	45
R5007	0203 1000	composition, 150K	ALB	EB
R5008	0203 0520	composition, 1.5K	ALB	EB
R5009	0203 1040	composition, 220K	ALB	EB
R5011 & R5012	0203 1650	composition, 100, ±10%	ALB	EB
R5013 & R5014	0203 0810	composition, 24K	ALB	EB
R5015	0237 5970	composition, 5.1	ALB	EB
R5016 & R5017	0203 0810	composition, 24K	ALB	EB
R5018	0237 1130	18K, 2W	CGW	C42S
R5019	0236 5760	1.21K, ±1%	CGW	NS20
R5021	0236 5760	1.21K, ±1%	CGW	NS20
R5022 & R5023	0203 0860	composition, 39K	ALB	EB
R5024	0203 0520	composition, 1.5K	ALB	EB
R5026 & R5027	0203 0700	composition, 8.2K	ALB	EB
R5028 & R5029	0203 1650	composition, 100, ±10%	ALB	EB
R5031	0109 1400	variable, composition, 250, ±20% (X AMP CAL)	CTS	45
R5032	0203 0300	composition, 180	ALB	EB
R5033 & R5034	0237 1000	5.1K, 2W	CGW	C32
R5036	0109 2670	variable, wirewound, 2K, ±10%, 4W (DP LEVEL ADJ)	CTS	AW
R5037	0203 0650	composition, 5.1K	ALB	EB
R5038 & R5039	0237 1690	5.1K, ±2%, 4W	CGW	S30
R5041F	0107 3061	variable, composition, 50K/50K, ±20%, 1W (X POSITION, PART OF S502)		
R5042	0229 4710	1.5M, ±1%	TEX	CD1/2PR
R5043	0234 9270	8.2K, 1W	CGW	C32

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
	RESISTORS (Continued)			
R5044	0236 7770	150K, ±1%	CGW	NS20
R5046	0237 9240	6.98K, ±1%, 1W	IRC	CES
R5047	0237 8890	3.01K, ±1%, 1W	IRC	CES
R5048	0237 8470	1.10K, ±1%, 1W	IRC	CES
R5049	0203 1030	composition, 200K	ALB	EB
R5051	0237 8150	511, ±1%, 1W	IRC	CES
R5052	0237 7830	237, ±1%, 1W	IRC	CES
R5053	0237 7330	71.5, ±1%, 1W	IRC	CES
R5054	0203 0810	composition, 24K	ALB	EB
R5056	0203 0570	composition, 2.4K	ALB	EB
R5057	0109 3520	variable, composition, 2.5K, ±20%, 1/4W (CAL UP VS LOW)	CTS	200RE
R6000	0237 1190	33K, 2W	CGW	C42S
R6001	0203 0960	composition, 100K	ALB	EB
R6002	0203 0380	composition, 390	ALB	EB
R6003	0234 8580	36K	CGW	C20
R6004	0234 8640	62K	CGW	C20
R6005	0203 0890	composition, 51K	ALB	EB
R6006	0237 0460	30, 2W	CGW	C42S
R6007	0203 0380	composition, 390	ALB	EB
R6008	0203 0890	composition, 51K	ALB	EB
R6009	0203 0380	composition, 390	ALB	EB
R6010	0234 8600	43K	CGW	C20
R6011	0235 4520	composition, 390, 1/4W	ALB	CB
R6012	0234 8480	13K	CGW	C20
R6013	0109 3370	variable, wirewound, 4K/4K, ±10%, 4W (-150V/+160V ADJ)	CTS	C2-AW
R6014	0234 8480	13K	CGW	C20
R6015	0234 8710	120K	CGW	C20
R6016	0203 0960	composition, 100K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
	RESISTORS (Continued)			
R6017	0203 0380	composition, 390	ALB	EB
R6018	0203 6580	composition, 2.7K, 2W	ALB	EB
R6021	0203 0780	composition, 18K	ALB	EB
R6022	0203 0380	composition, 390	ALB	EB
R6023	0236 6710	11.8K, ±1%	CGW	NS20
R6024	0236 6640	10K, ±1%	CGW	NS20
R6101	0203 0930	composition, 75K	ALB	EB
R6102	0203 0880	composition, 47K	ALB	EB
R6103	0236 7740	140K, ±1%	CGW	NS20
R6104	0236 6870	17.4K, ±1%	CGW	NS20
R6106	0236 8910	495K, ±1%	CGW	NS20
R6107	0236 8900	4.95K, ±1%	CGW	NS20
R6108	0236 4430	49.9, ±1%	CGW	NS20
R6109	0236 8910	495K, ±1%	CGW	NS20
R6111	0236 8900	4.95K, ±1%	CGW	NS20
R6112	0236 4430	49.9, ±1%	CGW	NS20
R6113	0236 8920	1.81K, ±1%	CGW	NS20
R6114	0236 8930	201, ±1%	CGW	NS20
R6115	0234 9290	10K, 1W	CGW	C32
R6117	0237 0350	10, 2W	CGW	C42S
R6118	0203 0380	composition, 390	ALB	EB
R6119	0235 4520	composition, 390, 1/4W	ALB	CB
R6121	0203 0380	composition, 390	ALB	EB
R6122	0203 0890	composition, 51K	ALB	EB
R6123	0203 0960	composition, 100K	ALB	EB
R6124	0203 0380	composition, 390	ALB	EB
R6125	0203 0780	composition, 18K	ALB	EB
R6126	0234 9410	33K, 1W	CGW	C20
R6128	0234 8450	10K	CGW	C20

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
	RESISTORS (Continued)			
R6201	0236 5990	2.1K, ±1%	CGW	NS20
R6202	0236 6470	6.65K, ±1%	CGW	NS20
R6203	0203 1010	composition, 160K	ALB	EB
R6204	0203 1820	composition, 2.7K, ±10%	ALB	EB
R6206	0203 1770	composition, 1K, ±10%	ALB	EB
R6207	0203 7700	composition, 270, ±10%, 2W	ALB	HB
R6208	0203 1850	composition, 4.7K, ±10%	ALB	EB
R6209	0203 7620	composition, 56, ±10%, 2W	ALB	HB
R6211 & R6212	0203 1770	composition, 1K, ±10%	ALB	EB
R6213	0107 2344	variable, wirewound, 50, ±10%, 2W (SCALE)	ABD	
R7001	0234 8450	10K	ALB	EB
R7002	0203 0580	composition, 2.7K	ALB	EB
R7003	0203 0760	composition, 15K	ALB	EB
R7004	0203 0720	composition, 10K	ALB	EB
R7005	0203 0940	composition, 82K	ALB	EB
R7006 & R7007	0203 0720	composition, 10K	ALB	EB
R7008	0203 3070	composition, 20, 1W	ALB	GB
R7009	0237 0550	68, 2W	CGW	C42S
R7011	0203 0630	composition, 4.3K	ALB	EB
R7012	0237 5970	composition, 5.1	ALB	EB
R7013	0203 0790	composition, 20K	ALB	EB
R7014	0203 1310	composition, 3M	ALB	EB
R7016	0236 3120	270K	ALB	EB
R7017	0109 1340	variable, composition, 100K 1/3W (HV ADJ)	CTS	45
R7018	0203 1030	composition, 200K	ALB	EB
R7019	0203 0720	composition, 10K	ALB	EB

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
	RESISTORS (Continued)			
R7021	0108 0760	variable, composition, 2.5M (LOWER FOCUS)	CLS	37
R7022	0203 4240	composition, 1.5M, 1W	ALB	HB
R7023	0203 1210	composition, 1.1M	ALB	EB
R7024	0203 1130	composition, 510K	ALB	EB
R7025	0203 4240	composition, 1.5M, 1W	ALB	HB
R7026	0203 1210	composition, 1.1M	ALB	EB
R7027	0203 1130	composition, 510K	ALB	EB
R7028	0108 0760	variable, composition, 2.5M (UPPER FOCUS)	CLS	37
R7029	0109 3410	variable, composition, 100K/100K 2-1/4W (X DEFL REG)	CPC	12 TWIN
R7031	0109 3240	variable, composition, 2.5M/2.5M (INT BAL)	CLS	D-37
R7032	0203 0850	composition, 36K	ALB	EB
R7033	0203 0850	composition, 36K	ALB	EB
R7034	0203 1360	composition, 4.7M	ALB	EB
R7036	0109 0080	variable, composition, 500K, ±20%, 1W (INTENSITY)	CLS	53C
R7037	0203 1360	composition, 4.7M	ALB	EB
R7038 & R7039	0203 1240	composition, 1.5M	ALB	EB
R7043	0109 0860	variable, composition, 100K, ±20%, 1/5W (UPPER ASTIG)	CTS	70
R7044	0109 0860	variable, composition, 100K, ±20%, 1/5W (LOWER ASTIG)	CTS	70
R7046	0109 3430	variable, composition, 500K/100K, 1/5W (PATT ADJ/TRACE REG)	CTS	C2-45

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE (Continued)

Symbol	Part Number	Description	Recommended Vendor Code	Type
		RESISTORS (Concluded)		
R7047 & R7048	0203 0640	composition, 4.7K	ALB	EB
R7049	0109 3460	variable, wirewound, 10K, ±20%, 2W (TRACE ALIGN)	CTS	118
R7051 & R7052	0203 1200	composition, 1M	ALB	EB
		SWITCHES		
S101	0501 7651	rotary, 3 sections, 10 positions (UPPER INPUT SEL)	ABD	
S102	0501 7632	rotary, 7 sections, 22 positions (UPPER ATTEN)	ABD	
S110 (part of R1137)	0107 2366	pull (VARIABLE)		
S111	0501 7671	rotary, 1 section, 3 positions (BANDWIDTH SEL)	ABD	
S120	0503 2540	push, SPDT (BEAM FINDER)	SWT	923
S201	0501 7651	rotary, 3 sections, 10 positions (LOWER INPUT SEL)	ABD	
S202	0501 7631	rotary, 7 sections, 22 positions (LOWER ATTEN)	ABD	
S210 (part of R2137)	0107 2366	pull VARIABLE		
S211	0501 7671	rotary, 1 section, 3 positions (BANDWIDTH SEL)	ABD	
S402	0503 2450	toggle, DPDT (SLOPE)	ALCO	MST205N
S401A/B	0501 7681	rotary, 2 sections (S401A-TRIG SELECTOR S401B-AUTO-RECUR)	ABD	
S410	0503 2450	toggle, DPDT (NORM-SINGLE)	ALCO	MST205N

Symbol	Part Number	Description	Recommended Vendor Code	Recommended Vendor Type
		SWITCHES (Concluded)		
S411	0503 2620	push, SPST, momentary (RESET)	GRY	40-1
S420	0501 7032	rotary, 3 sections, 19 positions (TIME/CM)	ABD	
S421 (part of R4201)	0107 2361	push pull (VARIABLE)		
S501	0503 2490	toggle, SPDT (AC-DC)	ALCO	MST105D
S502	0501 7661	rotary, 5 sections, 13 positions (X DISPLAY)	ABD	
S600	0503 2480	slide, DPDT, (115V/230V)	MUT	4633
S601		DPDT, part of R6213 (POWER)		
S602	0503 2420	thermostat, SPDT (THERMAL CUTOUT)	EMW	2200
		TRANSFORMERS		
T6001	2001 3792	power	ABD	
T7001	2001 4821	high voltage	ABD	
		ELECTRON TUBES		
V110	2501 2360	6085/E80CC	AMX	
V111	2501 1610	ECC82/12AU7	AMX	
V210	2501 2360	6085/E80CC	AMX	
V211	2501 1610	ECC82/12AU7	AMX	
V401	2501 2220	6DJ8/ECC88	AMX	
V402	2501 2220	6DJ8/ECC88	AMX	

ELECTRICAL PARTS LIST FOR TYPE 708A DUAL BEAM OSCILLOSCOPE (Concluded)

Symbol	Part Number	Description	Recommended Vendor Code	Type
	ELECTRON TUBES (Concluded)			
V410	2501 2220	6DJ8/ECC88	AMX	
V411	2501 2220	6DJ8/ECC88	AMX	
V412	2501 1550	6AU6A	EIA	
V501	2501 1690	ECC81/12AT7	AMX	
V601	2500 0810	5651	EIA	
V701	2501 0721*	CRT F7080-0-P2	ABD	
	2501 0722*	CRT F7080-0-P7	ABD	
	2501 0723*	CRT F7080-0-P11	ABD	
	2501 0724*	CRT F7080-0-P31	ABD	
	CABLE			
W6001	5030 1390	assembly	MIL	

*DEPENDING ON SALES ORDER

SECTION 6B

SPARE PARTS LIST

SPARE PARTS REQUIREMENTS

a. GENERAL

The Type 708A Dual Beam Oscilloscope is an extremely reliable and dependable instrument. Only components throughly tested and approved by the engineers of the Quality Assurance Department are used in this instrument. Continued performance tests, environmental and life testing of production units make certain your Type 708A Dual Beam Oscilloscope will give many years of satisfactory service.

Two lists of "running spares" are included to aid you in periodic maintenance. The running-spare parts lists include recommended quantities and reference symbol numbers. Section 6A of this Instruction Manual gives a complete listing of all components and their recommended vendors so that you may readily procure them from a local supply house or your own stores.

NOTE: The local Fairchild Scientific Instrument Field Engineering representative and his service organization can assist you in obtaining any additional components in the shortest possible time. To help expedite service, always give Type Number and Serial Number of the instrument; always specify the part number and give a description of the component (see Section 6A of this manual).

b. 500-HOUR SPARES (6-months)

The recommended 500-hour spares list given below should be used when stocking spares for a minimum of three instruments.

Symbol	Quantity
FUSES	
F600	2
F601	2
LAMPS	
DS5001	2
DS6200	1
DS6201	2

SPARE PARTS LIST (Continued)

b. 500-HOURS SPARES (6-months) Concluded

TRANSISTORS

Symbol	Quantity
Q1101	1
Q1103	1
Q1201	2
Q5001	1
Q5005	1
Q6001	1
Q6002	1
Q6003	1
Q6100	1
Q6103	1
Q6201	1
Q6202	1
Q6203	1
Q7001	1
Q7002	1

ELECTRON TUBES

V110	1
V111	1
V401	1
V412	1
V501	1
V601	1
V701	1

SEMICONDUCTORS

CR1101	1
CR4100	3
CR4103	1
CR4104	1
CR5001	1
CR6001	2
CR7002	1
CR7003	1
CR7004	1
CR7007	1

SPARE PARTS LIST (Continued)

c. 2000-HOUR SPARES (2 years)

The recommended 2000-hour spares list given below should be used when stocking spares for one through ten instruments. Maintain spares indicated plus one for each plug-in in use; also maintain 1 of each set of the 500-hour spare list given in paragraph b.

CAPACITORS

Symbol	Quantity
C1001	1
C1002	1
C1004	1
C1006	1
C1008	2
C1009	3
C1019	1
C1021	2
C1101	1
C1102	1
C1103	3
C1109	5
C1111	1
C1113	4
C1118	1
C1119	1
C1201	1
C1203	1
C1207	1
C2004	1
C2006	1
C2019	1
C4001	1
C4002	1
C4003	1
C4007	1
C4008	1
C4009	1
C4101	1
C4102	1
C4106	1
C4107	1
C4109	1
C4111	1
C4202	1
C4203	1
C4204	1
C4206	1
C4207	1
C5001	1
C5002	1
C5007	1
C6001	1

SPARE PARTS LIST (Continued)

CAPACITORS (Concluded)

Symbol	Quantity
C6012	1
C6103	1
C6108	1
C6201	1
C6204	1
C7002	1
C7005	1
C7007	1
C7008	1
C7009	1
C7017	1

ELECTRICAL CONNECTORS

J1001	1
J6100	1
J5001	1
J6001	1
J7001	1

RESISTORS

Symbol	Quantity	Symbol	Quantity
R1001	1	R1127	1
R1003	1	R1128	5
R1004	1	R1129	1
R1006	1	R1132	1
R1007	1	R1136	1
R1013	1	R1137	1
R1014	1	R1138	1
R1016	1	R1139	1
R1017	1	R1141	1
R1018	1	R1146	1
R1019	1	R1148	1
R1101	1	R1149	1
R1102	1	R1152	1
R1103	1	R1201	1
R1105	1	R1202	2
R1106	1	R1203	1
R1107	1	R1208	1
R1111	1	R1211	1
R1113	1	R1212	3
R1116	1	R1213	1
R1117	1	R1216	1
R1119	1	R1218	1
R1122	1	R1219	1
R1123	1	R1221	1
R1126	1	R1223	1

SPARE PARTS LIST (Continued)

c. 2000-HOUR SPARES (2-years) Continued

RESISTORS (Continued)

Symbol	Quantity	Symbol	Quantity
R1224	1	R5003	1
R1226	1	R5004	1
R1227	1	R5015	1
R1228	1	R5018	1
R2204	1	R5019	1
R2226	2	R5027	1
R2228	2	R5031	1
R2229	1	R5032	1
R4001	1	R5036	1
R4002	1	R5037	1
R4003	1	R5038	1
R4004	1	R5041F	1
R4005	1	R5042	1
R4006	1	R5046	1
R4012	1	R5047	1
R4014	1	R5048	1
R4016	1	R5049	1
R4017	1	R5051	1
R4019	1	R5052	1
R4024	1	R5053	1
R4032	1	R5056	1
R4101	1	R5057	1
R4103	1	R6000	1
R4106	1	R6004	1
R4107	1	R6006	1
R4108	1	R6010	1
R4112	1	R6011	1
R4117	1	R6012	1
R4118	1	R6013	1
R4121	1	R6015	1
R4122	1	R6018	1
R4123	1	R6023	1
R4126	1	R6024	1
R4127	1	R6104	1
R4128	1	R6106	1
R4129	1	R6107	1
R4132	1	R6108	1
R4134	1	R6113	1
R4135	1	R6114	1
R4136	1	R6115	1
R4137	1	R6117	1
R4141	1	R6119	1
R4145	1	R6126	1
R4201	1	R6128	1
R4204	1	R6201	1
R4208	1	R6202	1
R4209	1	R6204	1
R5002	1	R6206	1

SPARE PARTS LIST (Continued)

c. 2000-HOUR SPARES (2 years) Continued

RESISTORS (Concluded)

Symbol	Quantity	Symbol	Quantity
R6207	1	R7023	1
R6208	1	R7024	1
R6209	1	R7029	1
R6213	1	R7031	1
R7002	1	R7032	1
R7005	1	R7034	1
R7008	1	R7036	1
R7009	1	R7038	1
R7011	1	R7046	1
R7016	1	R7049	1
R7022	1		

TRANSFORMERS & COIL

Symbol	Quantity
T6001	1
T7001	1
L7001	1

SPARE PARTS LIST (Concluded)

c. 2000-HOUR SPARES (2-years)

SWITCHES

Stock only one each of the following switches for each ten units being maintained:

S101	S202	S420	S602
S102	S401A/B	S421	
S110	S402	S501	
S111	S410	S502	
S120	S411	S600	

d. MISCELLANEOUS

The following items may be stocked in quantities of one for each ten units being maintained:

Name	Part Number
Bushing, Shaft	4301 3581
Connector, BNC	0905 7610
Knob, Upper & Lower Beam	4501 2811
Knob, Bar	4501 2572
Knob, Red	4501 0410
Knob, Black (large)	4501 0380
Knob, Ring Front	4501 0441
Knob, Black (small)	4501 0400
Knob, Knurled, Ground Post	4501 2191
Panel, Front	3201 4201
Ring, Front	3506 2001
Scale, illuminated	4501 2461
Tilt Foot, Modified	3506 5892
Tilt Foot	3506 5242
Tilt Support	3506 6931
Washer, Rubber	3801 8381

e. SUMMARY

The quantities of spare parts given in the preceding paragraphs are intended for industrial and military duty under normal environment and heavy-use conditions. It is suggested that the maintenance engineer evaluate:

1. The conditions under which the instruments will be used.
2. The skill of the maintenance technicians.
3. Other similar items on hand.
4. The effect of procurement time of spares and effects of instrument down-time on your organization.

It is recommended that inventories of spare parts outlined above be adjusted accordingly to the requirements of your own laboratory or plant.

In the first analysis, the factory recommends the availability of spares or standby equipments since extensive life testing of your instrument has shown no higher failure rate for any specific component.

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
AUT	Automatic Metal Products Corporation
BEL	Belfuse
BNS	Bourns Inc.
BUR	Burndy Engrg. Company
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon
COM	Comar Electric
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
CUR	Curtis Inst.
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EDL	Edal Industries
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FAST	John E. Fast Company
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
FTN	Filtron Co. Inc.
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GEN	General Instrument Corporation
GEP	General Products Corporation
GLB	Globe Industries
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HAM	The Hammarlund Manufacturing Co., Inc.
HOF	Hoffman
HON	Honeywell
HOP	Hopkins Engineering Company
HP	Hewlett-Packard Company

CODE	NAME
IDI	Industrial Device
IEC	International Electronics Corporation
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LED	Ledex Inc.
LEE	Leecraft Mfg. Company
LFI	Littlefuse, Inc.
LIN	Line Electric
MAL	P. R. Mallory & Company, Inc.
MCR	Micro Switch (Division of Minneapolis-Honeywell Regulator Co.)
MCT	Microtran
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOT	Motorola Semiconductor Products, Inc.
MOV	M-O Valve Company Ltd.
MSW	Micro Switch
MUC	Mucon Corporation
MUL	Mull Holland
MUT	The Muter Company
NSW	Milli Switch
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SIL	Silicon Transistor Corporation
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWT	Switchcraft
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TNS	Transiton Corp.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
UID	United International Dynamic Corp.
UTC	United Transformer Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

The Scientific Instrument Department warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Fairchild, the Instrument is determined to be defective in workmanship or material, Fairchild will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Fairchild shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Fairchild be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Fairchild service organization or an employee thereof. Nor to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Fairchild's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Fairchild or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is required, please first contact the factory or authorized dealer, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

FAIRCHILD
Instrumentation
Scientific Instrument Dept.
750 Bloomfield Avenue, Clifton, New Jersey

The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

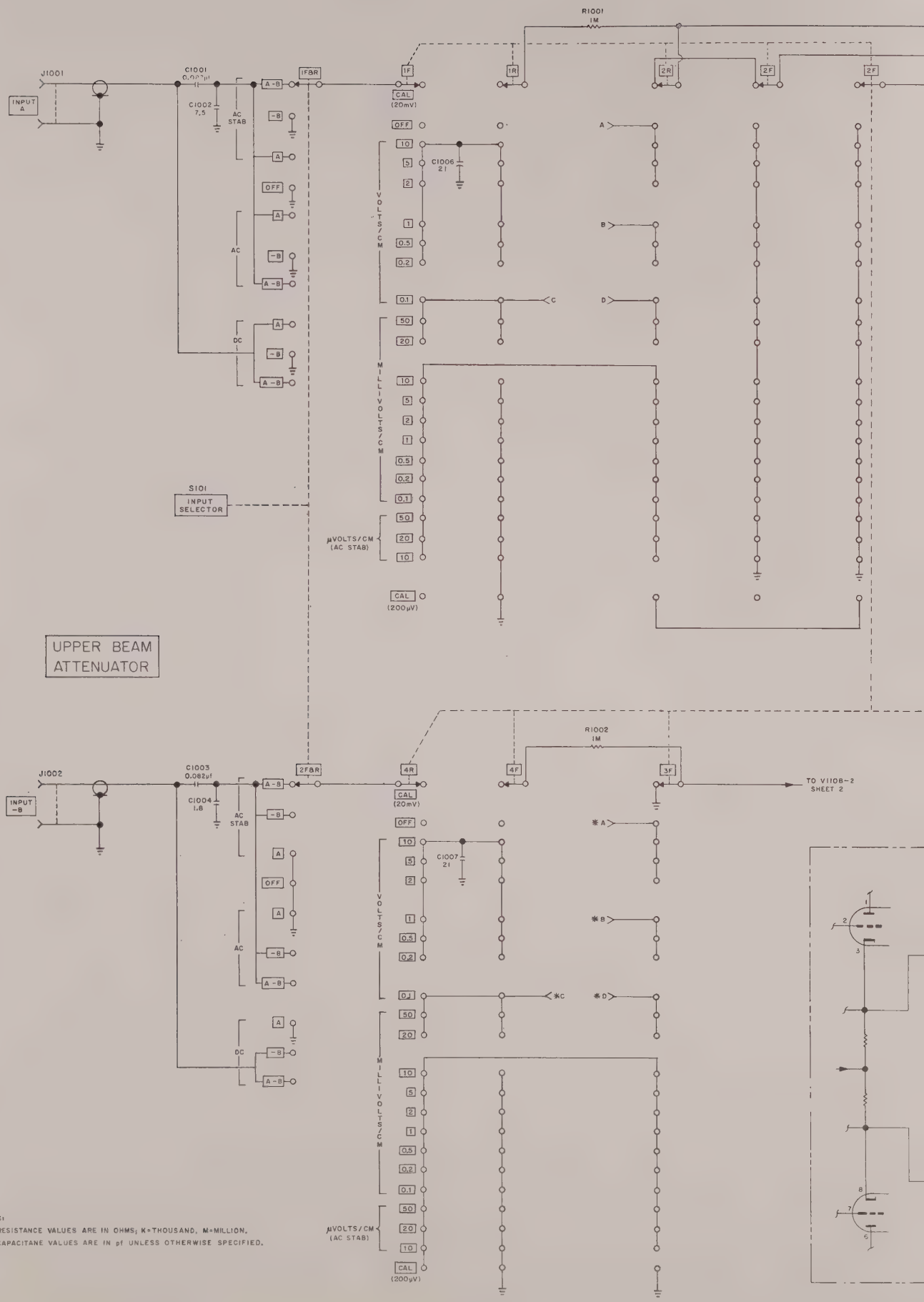
REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Fairchild part number for all electrical components used in the Instrument. This will help to expedite service.

PATENT NOTICE

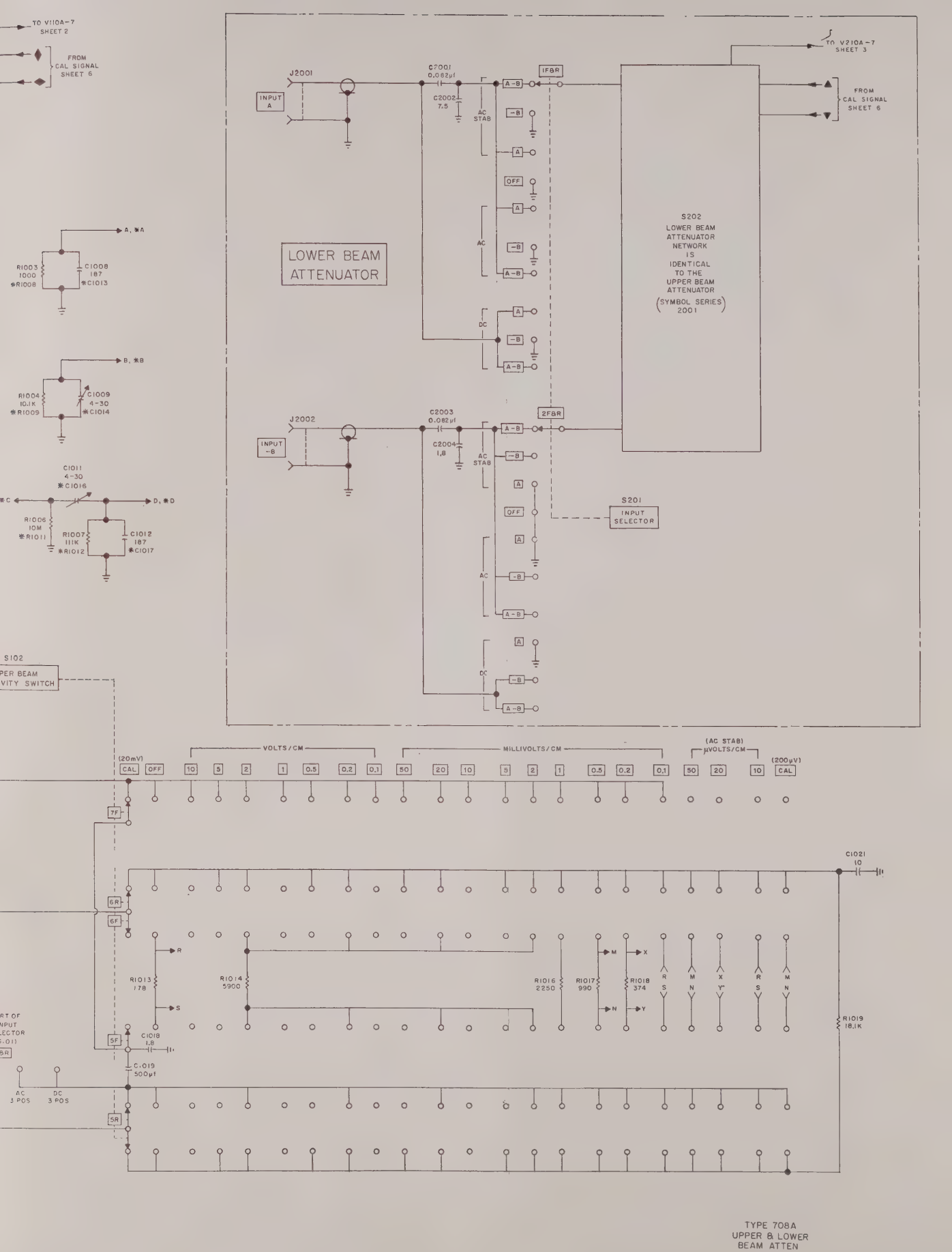
Manufactured under one or more U. S. Patents owned or controlled by Fairchild Camera and Instrument Corporation, 750 Bloomfield Avenue, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.

WARRANTY REGISTRATION
SCIENTIFIC INSTRUMENT
IMPORTANT—FILL OUT AND MAIL THIS CARD—NO STAMP REQUIRED
EQUIPMENT WAS PURCHASED
SEE INSTRUCTION MANUAL FOR WARRANTY NOTICE
VOID UNLESS MAILED WITHIN 30 DAYS AFTER RECEIPT

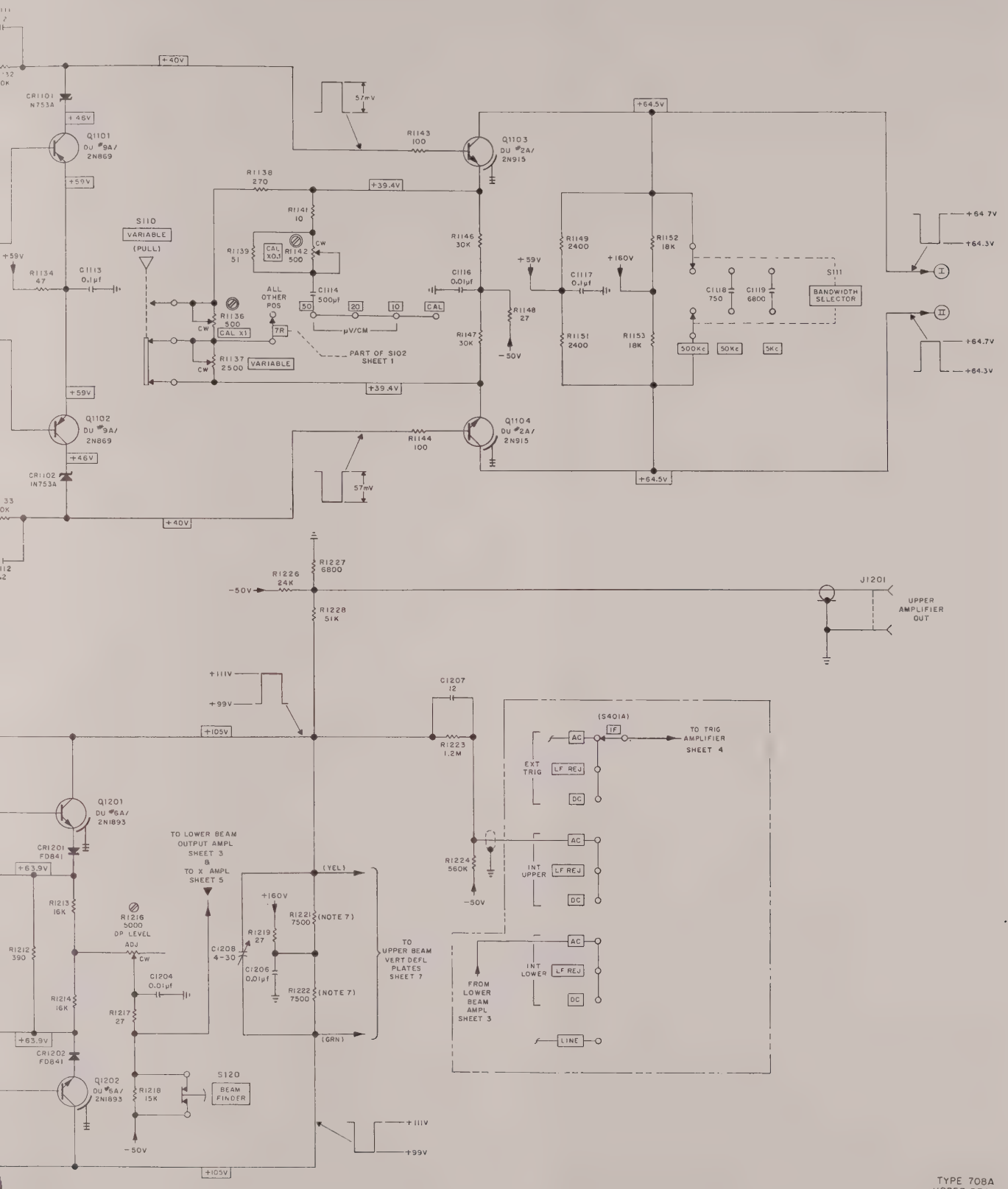


NOTES:

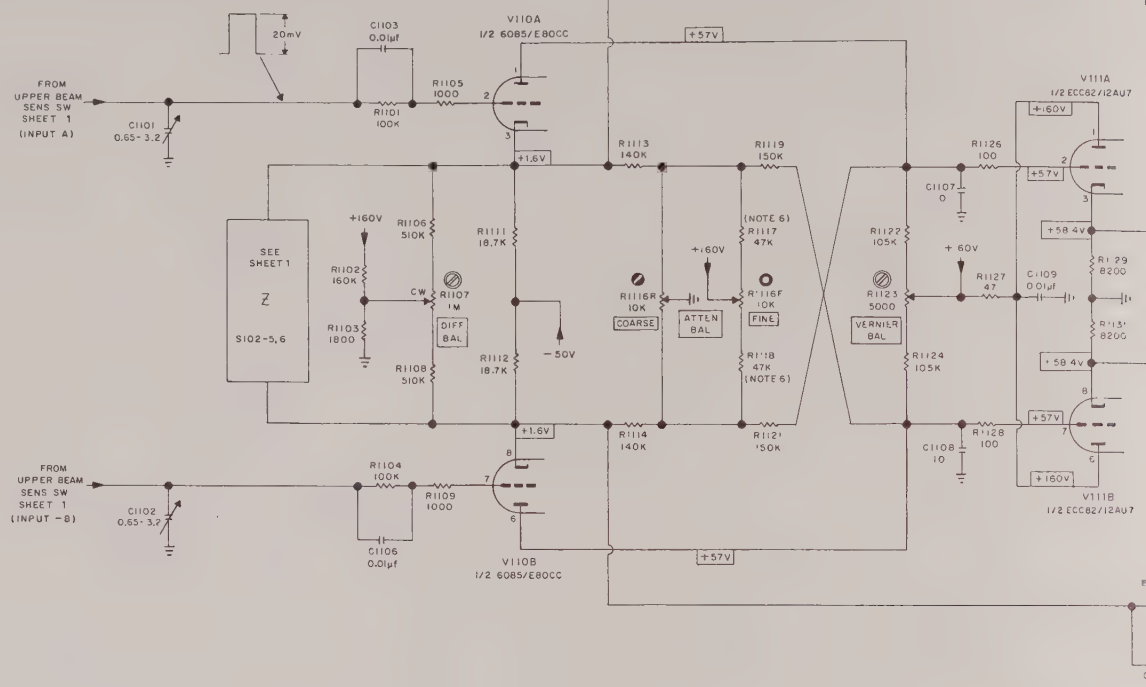
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.



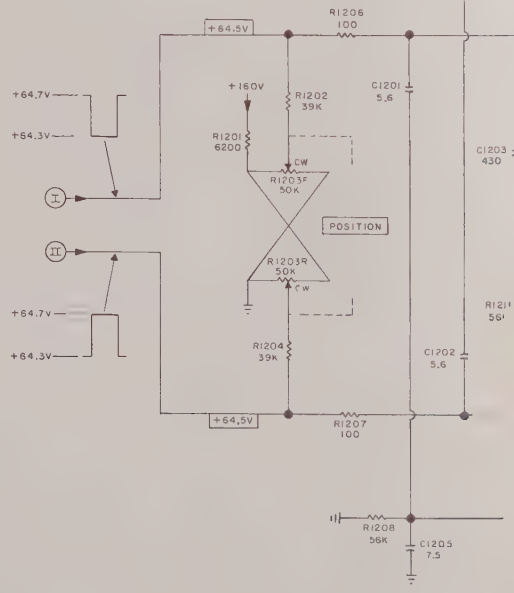
TYPE 708A
UPPER & LOWER
BEAM ATTEN
SHEET 1 OF 7



TYPE 708A
UPPER BEAM
VERT DEFL
AMPLIFIER
SHEET 2 OF 7



UPPER BEAM VERTICAL DEFLECTION AMPLIFIER



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	5 mSEC
X DISPLAY	SWEEP X1
TRIG SOURCE	INT. UPPER
TRIG SLOPE	(+)
UPPER BEAM SEN CAL	
LOWER BEAM SEN CAL	

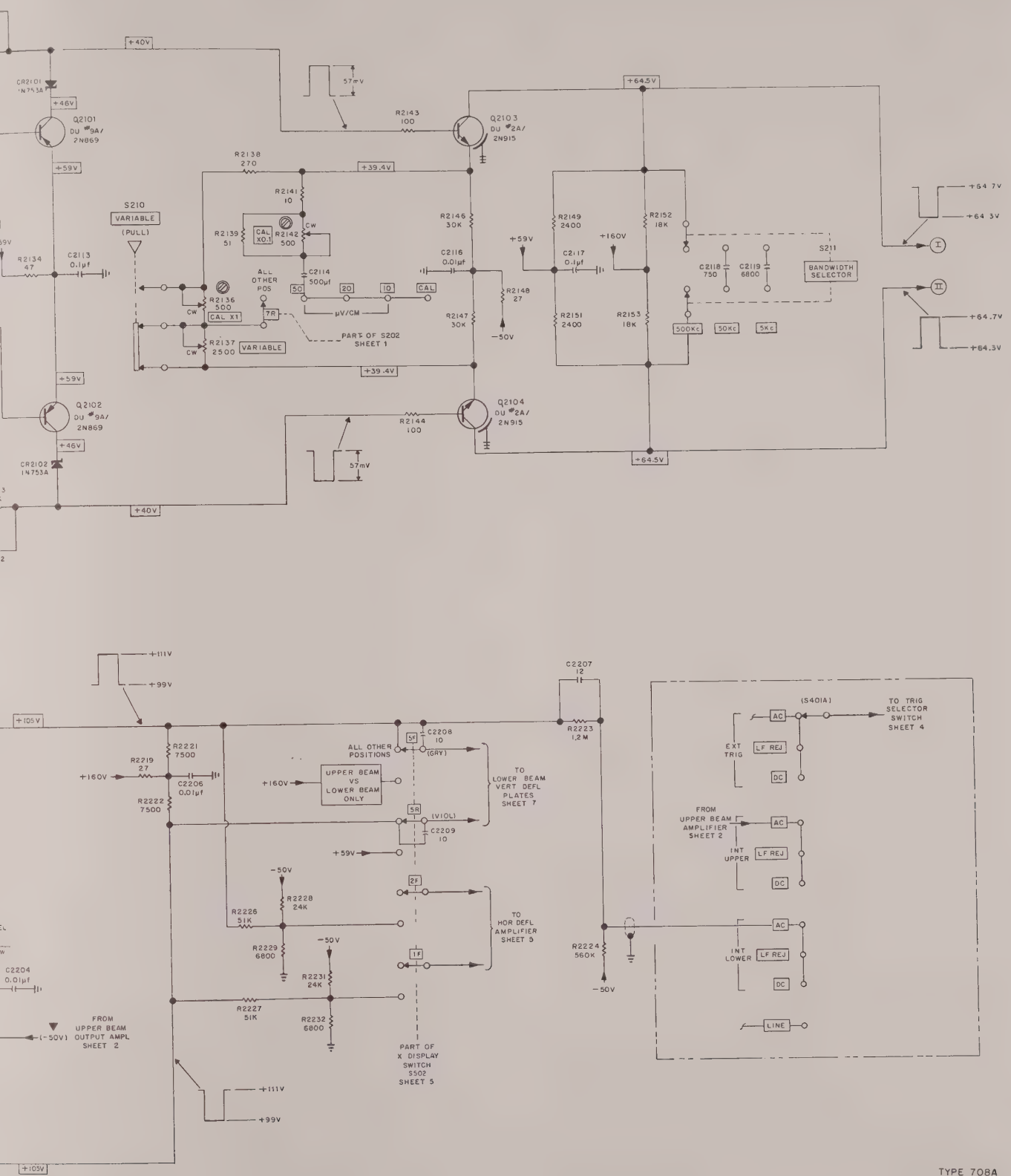
3. Voltage tolerance ±15% with respect to ground.

WAVEFORM DATA

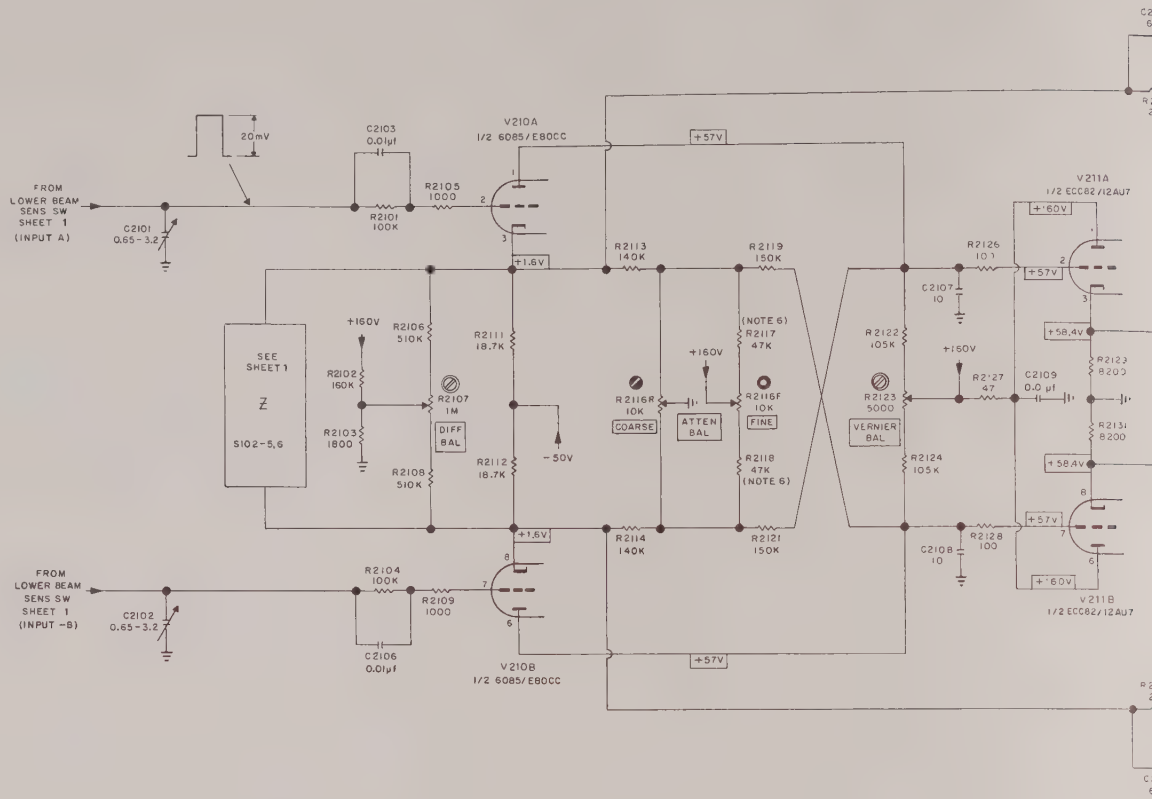
4. Use Type 4290 Series Probe (X10)
5. Use Type 766H Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.

NOTES:

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ⊘ SERVICE ADJUSTMENT.
5. HEAT SINK.
6. R1117 & R1118 MUST BE FIXED FILM TYPE RESISTOR.
7. R1221 & R1222 MUST BE CGW TYPE C-42.



TYPE 708A
LOWER BEAM
VERT DEFL
AMPLIFIER
SHEET 3 OF 7



LOWER BEAM VERTICAL DEFLECTION AMPLIFIER

VOLTAGE DATA

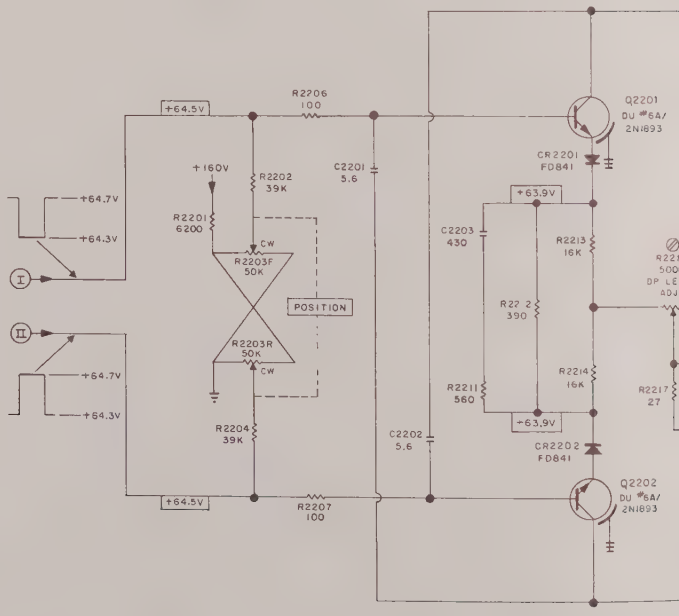
1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	5 mSEC
X DISPLAY	SWEEP X1
TRIG SOURCE	INT. UPPER
TRIG SLOPE	(+)
UPPER BEAM SEN	CAL
LOWER BEAM SEN	CAL

3. Voltage tolerance ±15% with respect to ground.

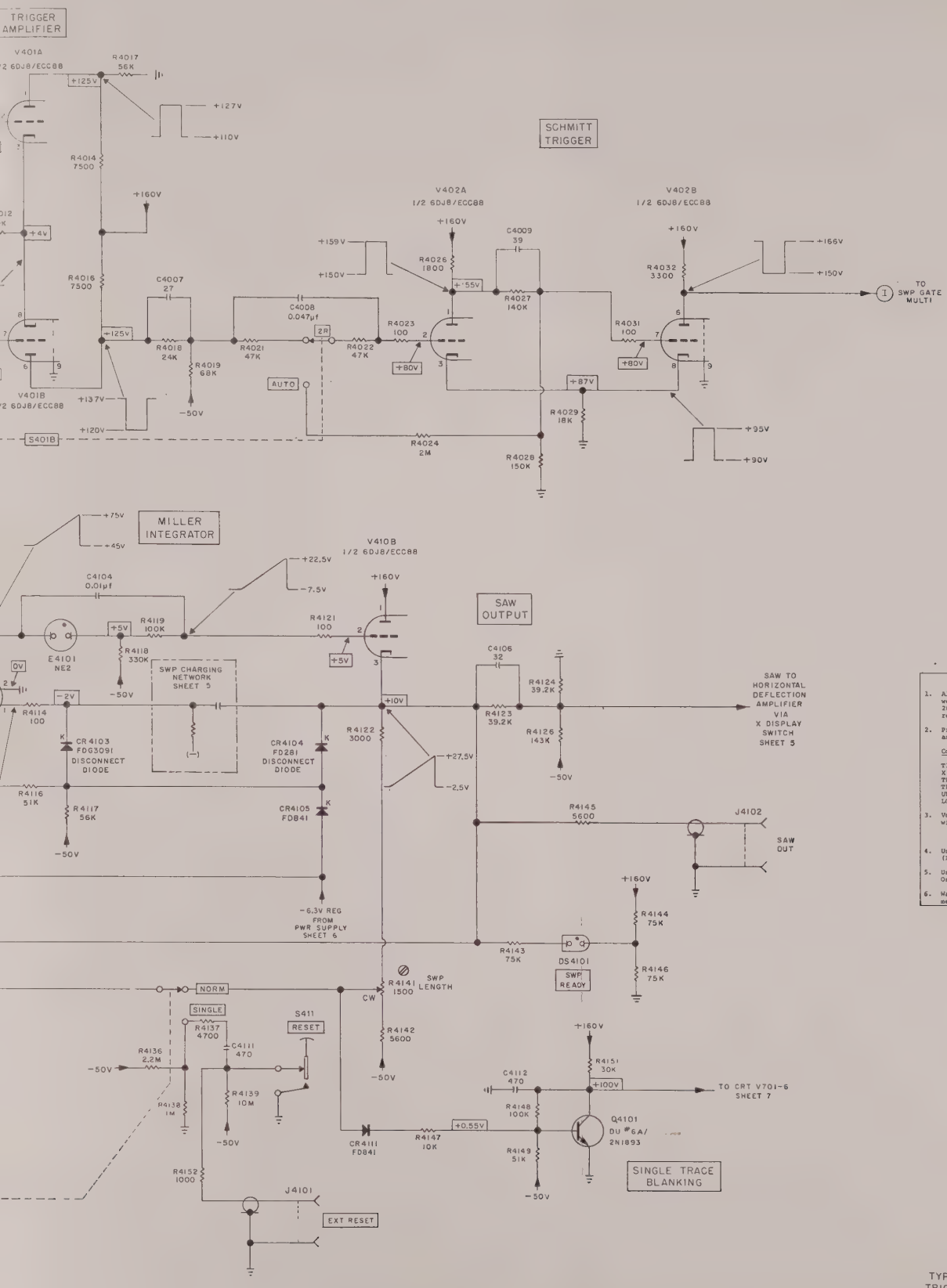
WAVEFORM DATA

4. Use Type 4290 Series Probe (X10)
5. Use Type 766H Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ⊘ SERVICE ADJUSTMENT.
5. HEAT SINK.
6. R2117 & R2118 MUST BE FIXED FILM TYPE RESISTOR.
7. R2221 & R2222 MUST BE CGW TYPE C-42S.



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

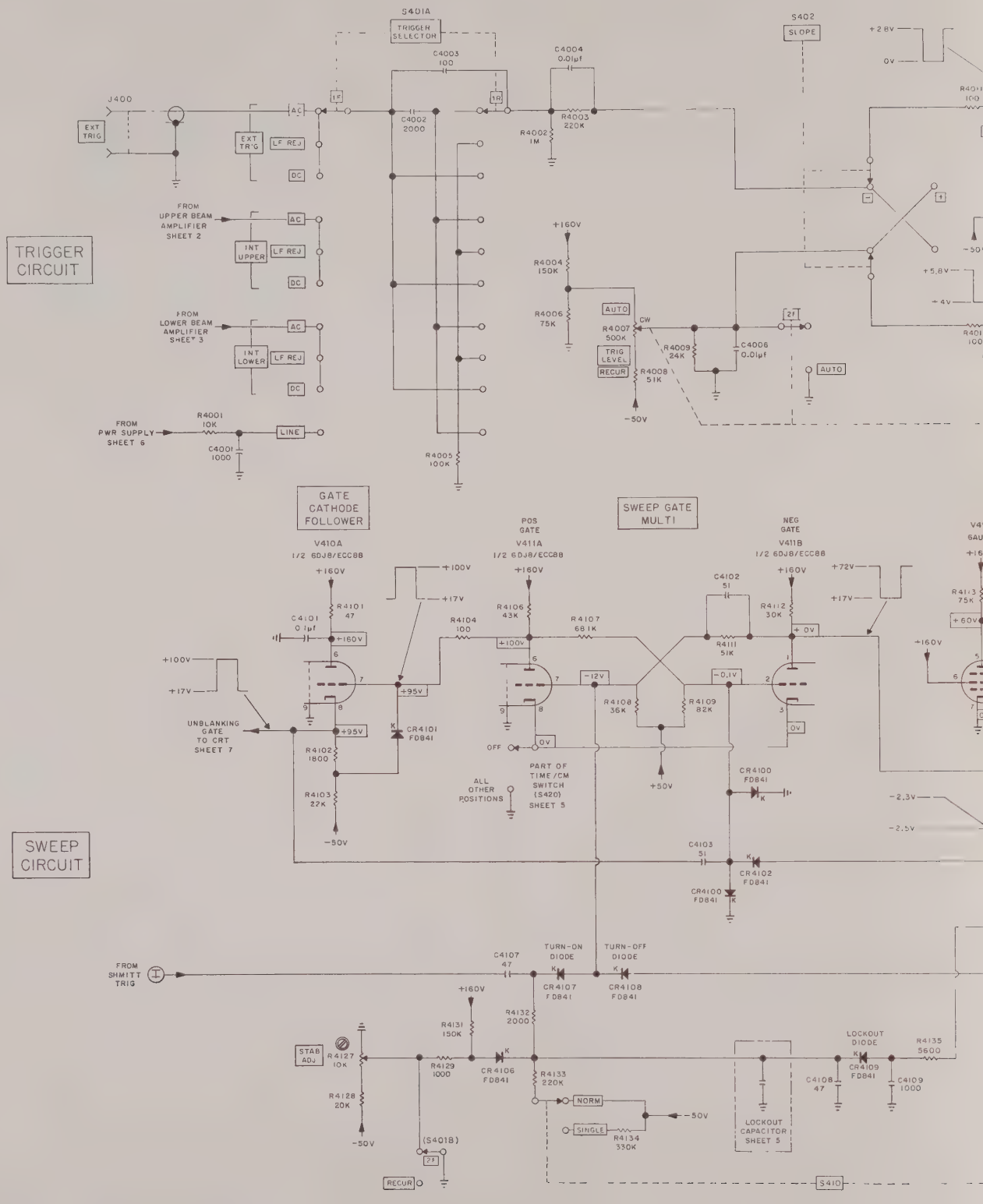
Control	Setting
TIME/CM	5 mSEC
X DISPLAY	SWEEP X1
TRIG SOURCE	INT. UPPER
TRIG SLOPE	(+)
UPPER BEAM SEN	CAL
LOWER BEAM SEN	CAL

3. Voltage tolerance ±15% with respect to ground.

WAVEFORM DATA

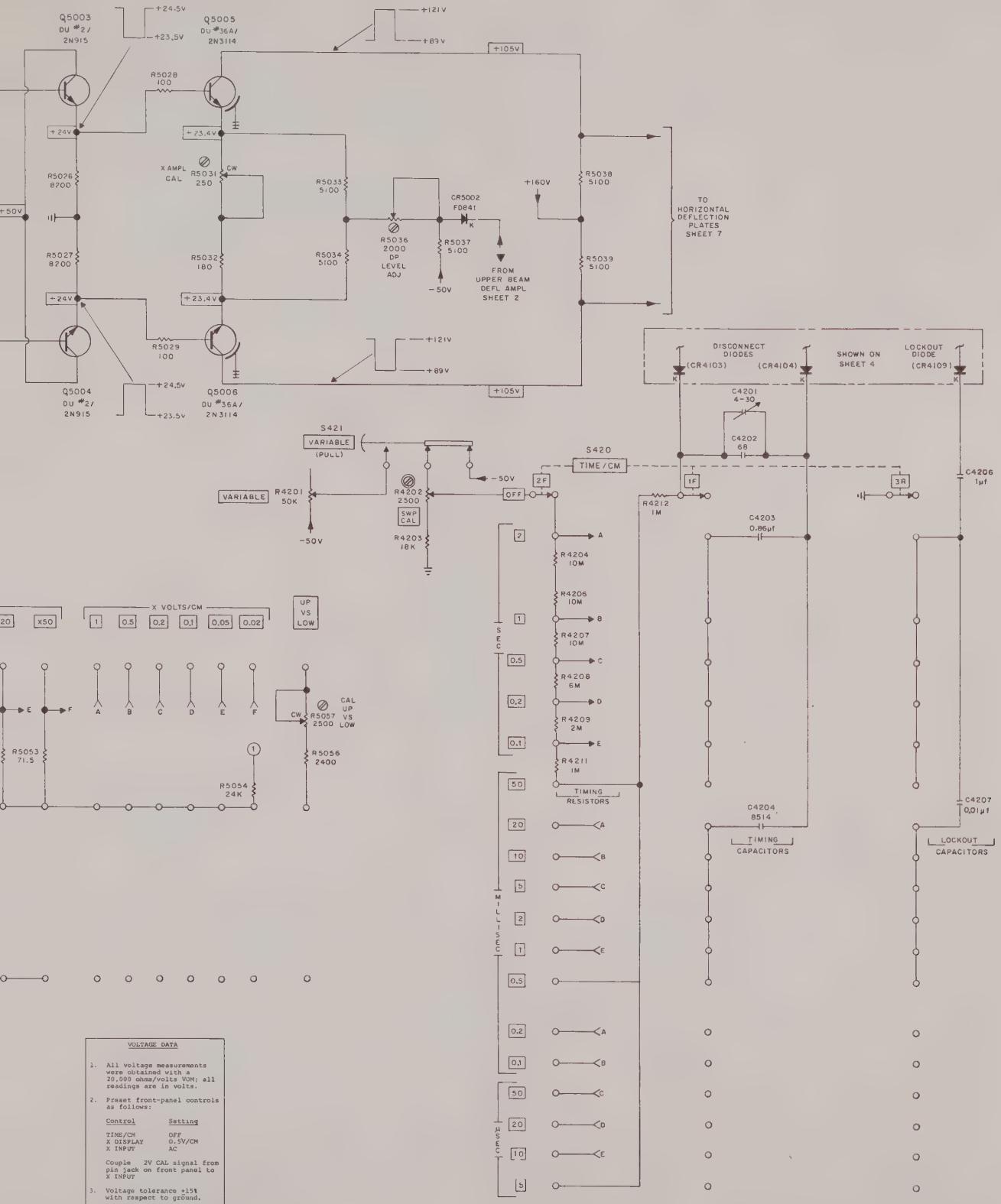
4. Use Type 4290 Series Probe (X10)
5. Use Type 766H Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.

TYPE 708A
TRIG & SWP
CIRCUITS
SHEET 4 OF 7



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	OFF
X DISPLAY	0.5V/CM
X INPUT	AC

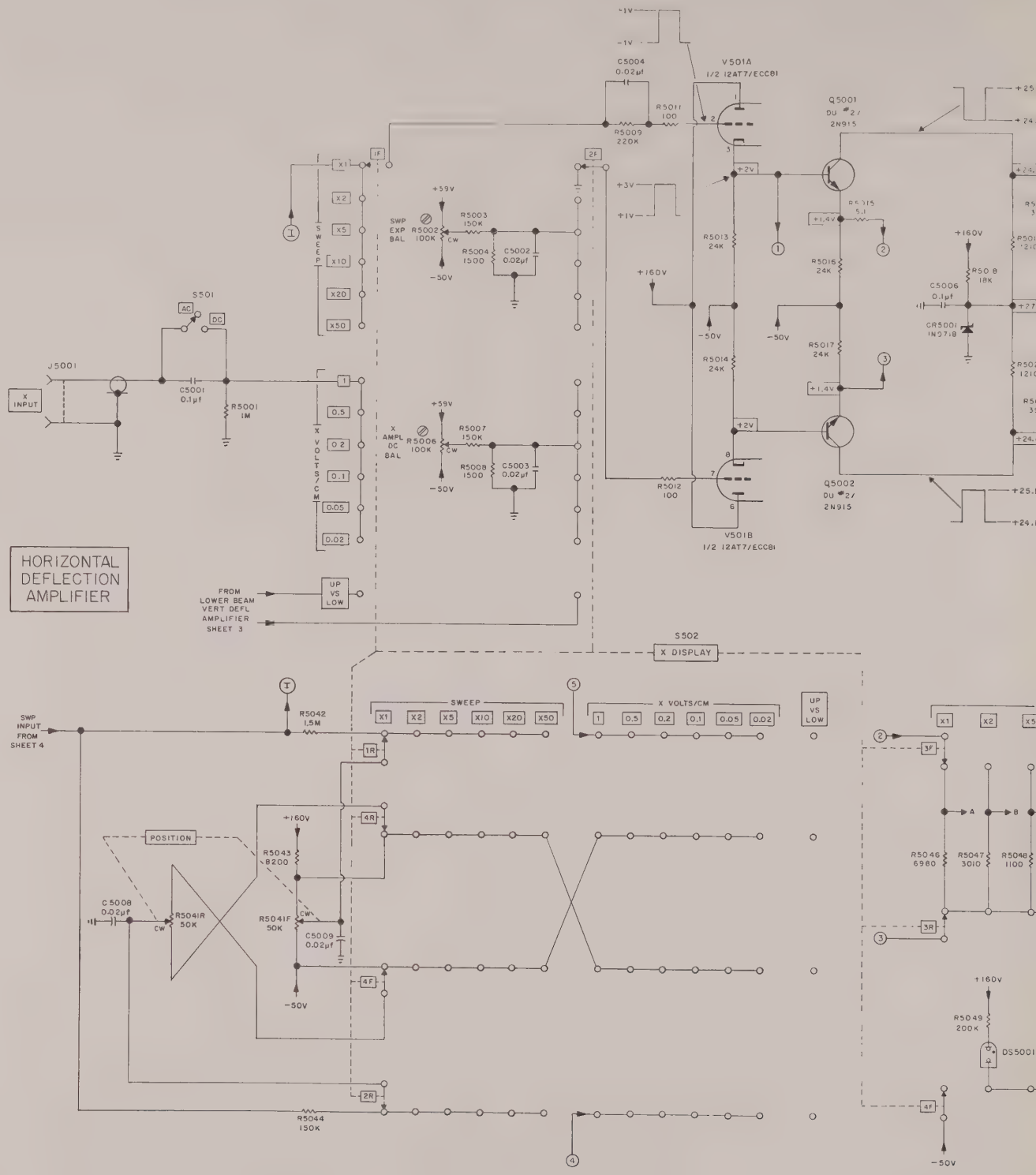
Couple 2V CAL signal from pin jack on front panel to X INPUT

3. Voltage tolerance ±15% with respect to ground.

WAVEFORM DATA

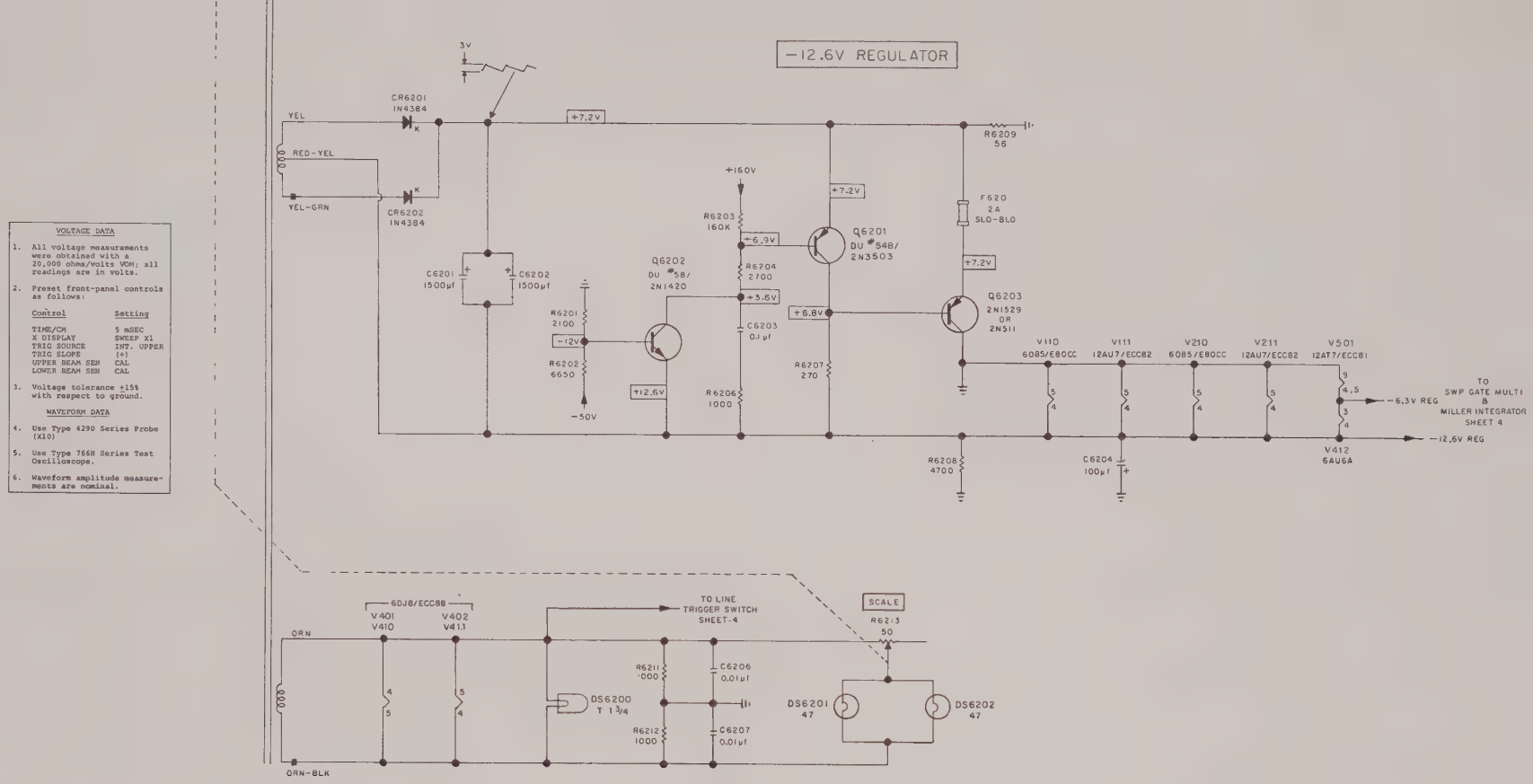
4. Use Type 4290 Series Probe (X10).
5. Use Type 766N Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.

TYPE 708A
HOR DEFL
AMPLIFIER
SHEET 5 OF 7



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ◎ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ○ SERVICE ADJUSTMENT.
5. HEAT SINK.
6. ▼ COMMON CONNECTION.



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	5 mSEC
X DISPLAY	SWEEP X1
TRIG SOURCE	INT. UPPER
TRIG SLOPE	(+)
UPPER BEAM SEN	CAL
LOWER BEAM SEN	CAL

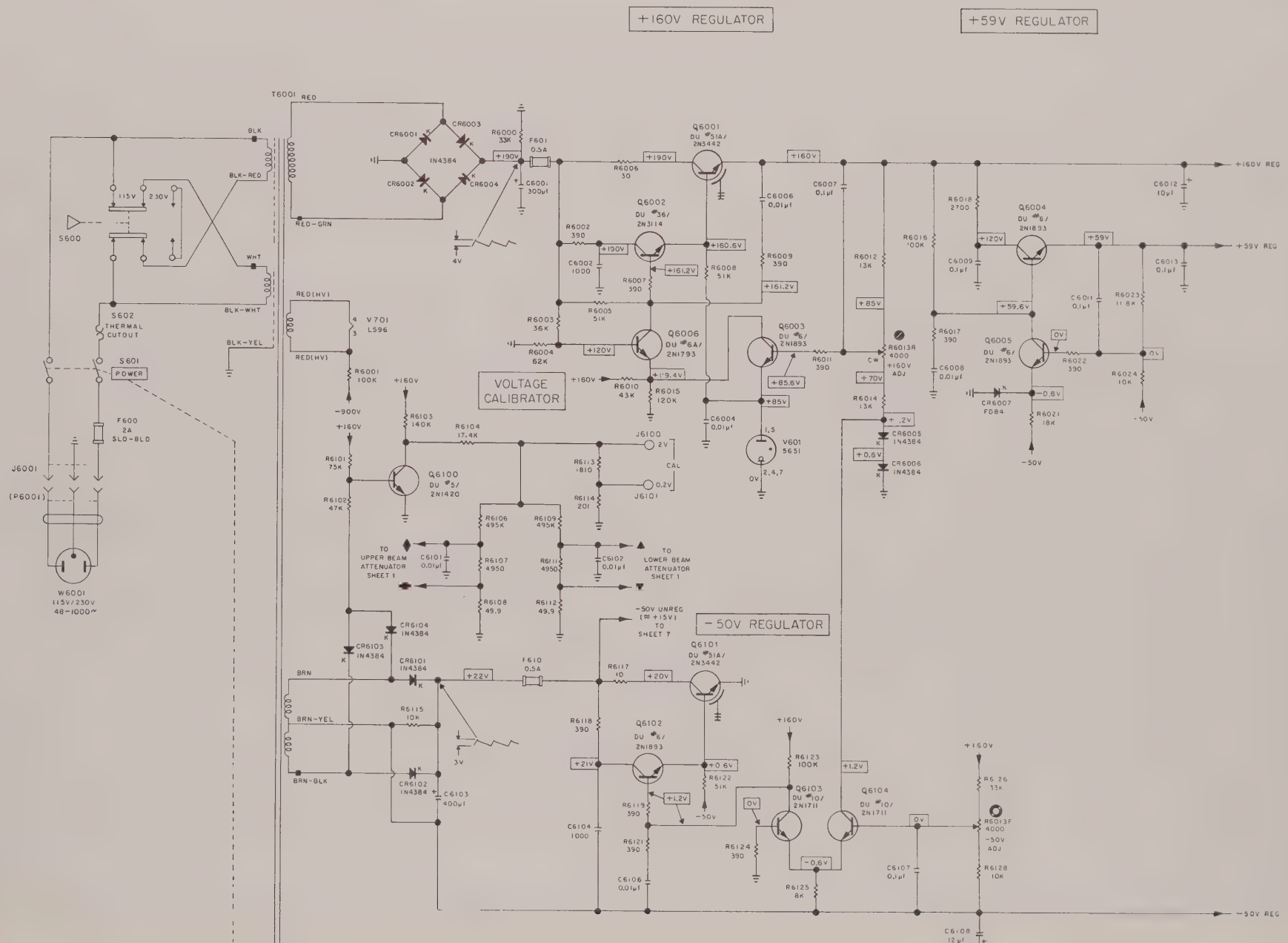
3. Voltage tolerance ±15% with respect to ground.

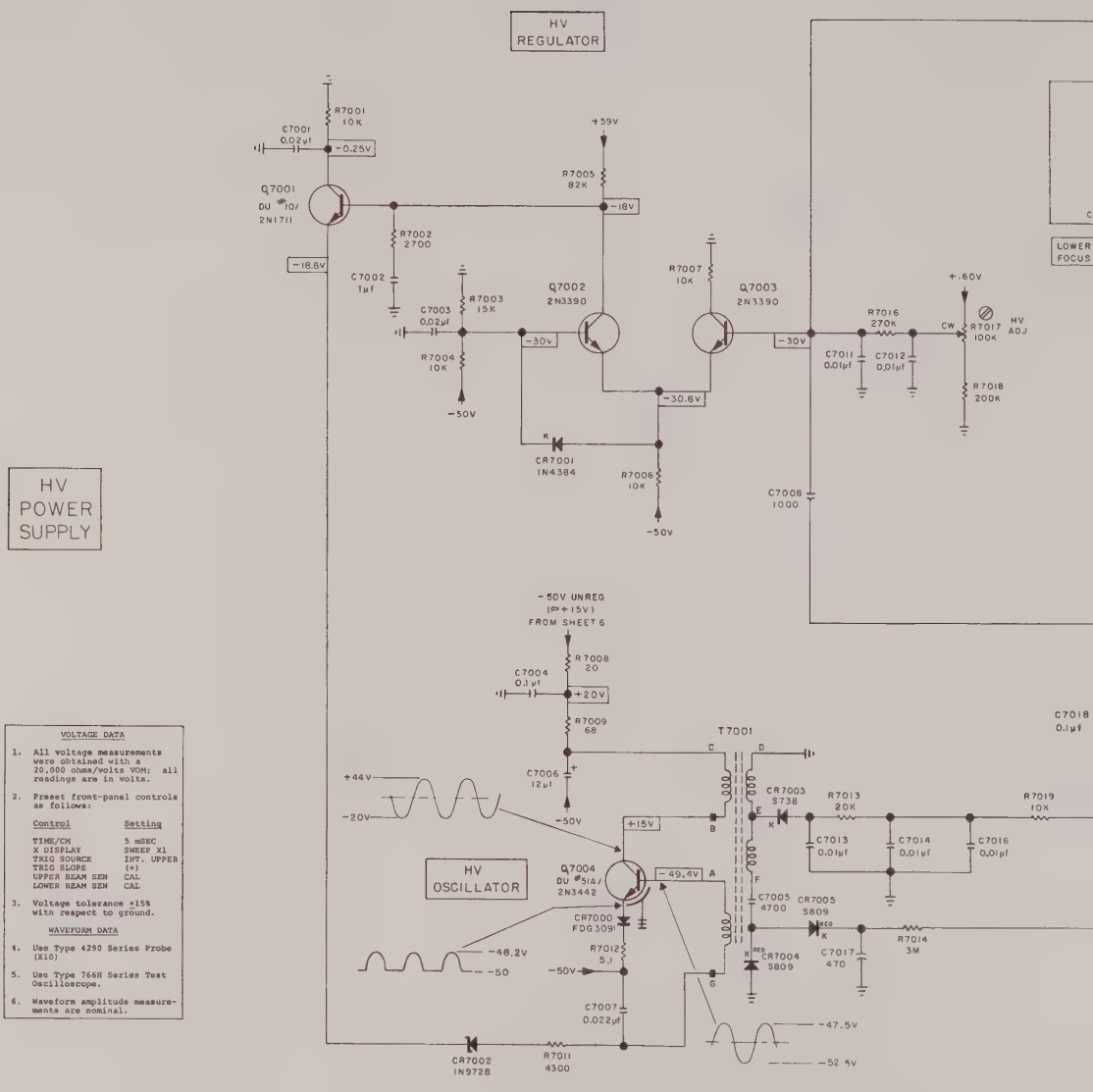
WAVEFORM DATA

4. Use Type 4290 Series Probe (X10)
5. Use Type 766H Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.

NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK

TYPE 70BA
LV PWR
SUPPLY
SHEET 6 OF 7


+160V REGULATOR
+59V REGULATOR
-50V REGULATOR
VOLTAGE CALIBRATOR
T6001
RED
BLK
BLK-RED
WHT
BLK-WHT
BLK-YEL
RED-GRN
S600
115V
230V
S602
THERMAL CUTOUT
S601
POWER
F600
2A
SLO-BLO
J6001
(P6001)
W6001
115V/230V
48-1000~
CR6001
CR6002
CR6003
CR6004
IN4384
R6000
33K
F601
0.5A
C6001
300µf
+190V
R6006
30
Q6001
DU *51A/
2N3442
+160V
+160V REG
C6006
0.01µf
C6007
0.1µf
C6012
10µf
Q6002
DU *36/
2N3114
R6002
390
+160.6V
+161.2V
R6009
390
R6008
51K
C6002
1000
R6007
390
R6005
51K
R6003
36K
R6004
62K
+120V
Q6006
DU *6A/
2N1793
+119.4V
R6010
43K
R6015
120K
Q6003
DU *6/
2N1893
+85.6V
+85V
R6011
390
R6012
13K
R6013R
4000
+160V
ADJ
CW
+70V
R6014
13K
+.2V
CR6005
IN4384
+0.6V
CR6006
IN4384
C6004
0.01µf
V601
5651
1,5
2,4,7
0V
R6018
2700
Q6004
DU *6/
2N1893
+120V
+59V
+59V REG
C6009
0.1µf
C6013
0.1µf
R6016
100K
C6011
0.1µf
R6023
11.8K
+59.6V
R6017
390
C6008
0.01µf
Q6005
DU *6/
2N1893
0V
R6022
390
R6024
10K
-0.6V
CR6007
FD84
R6021
18K
-50V
R6001
100K
-900V
V701
L596
RED(HV)
+160V
R6103
140K
R6104
17.4K
R6101
75K
R6102
47K
Q6100
DU *5/
2N1420
J6100
2V
CAL
0.2V
J6101
R6113
1810
R6114
201
TO UPPER BEAM ATTENUATOR SHEET 1
TO LOWER BEAM ATTENUATOR SHEET 1
R6106
495K
R6109
495K
C6101
0.01µf
C6102
0.01µf
R6107
4950
R6111
4950
R6108
49.9
R6112
49.9
-50V UNREG
(≈ +15V)
TO
SHEET 7
CR6104
IN4384
CR6103
IN4384
CR6101
IN4384
+22V
F610
0.5A
R6117
10
+20V
Q6101
DU *51A/
2N3442
BRN
BRN-YEL
BRN-BLK
R6115
10K
3V
CR6102
IN4384
C6103
400µf
R6118
390
Q6102
DU *6/
2N1893
+21V
+0.6V
R6122
5K
R6119
390
+1.2V
-50V
C6104
1000
R6121
390
C6106
0.01µf
+160V
R6123
100K
+1.2V
Q6103
DU *10/
2N1711
Q6104
DU *10/
2N1711
0V
R6124
390
-0.6V
R6125
8K
C6107
0.1µf
+160V
R6 26
33K
R6013F
4000
-50V
ADJ
R6128
10K
-50V REG
C6108
12µf



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volts VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
TIME/CM	5 mSEC
X DISPLAY	SWEEP X1
TRIG SOURCE	INT. UPPER
TRIG SLOPE	(+)
UPPER BEAM SEN	CAL
LOWER BEAM SEN	CAL

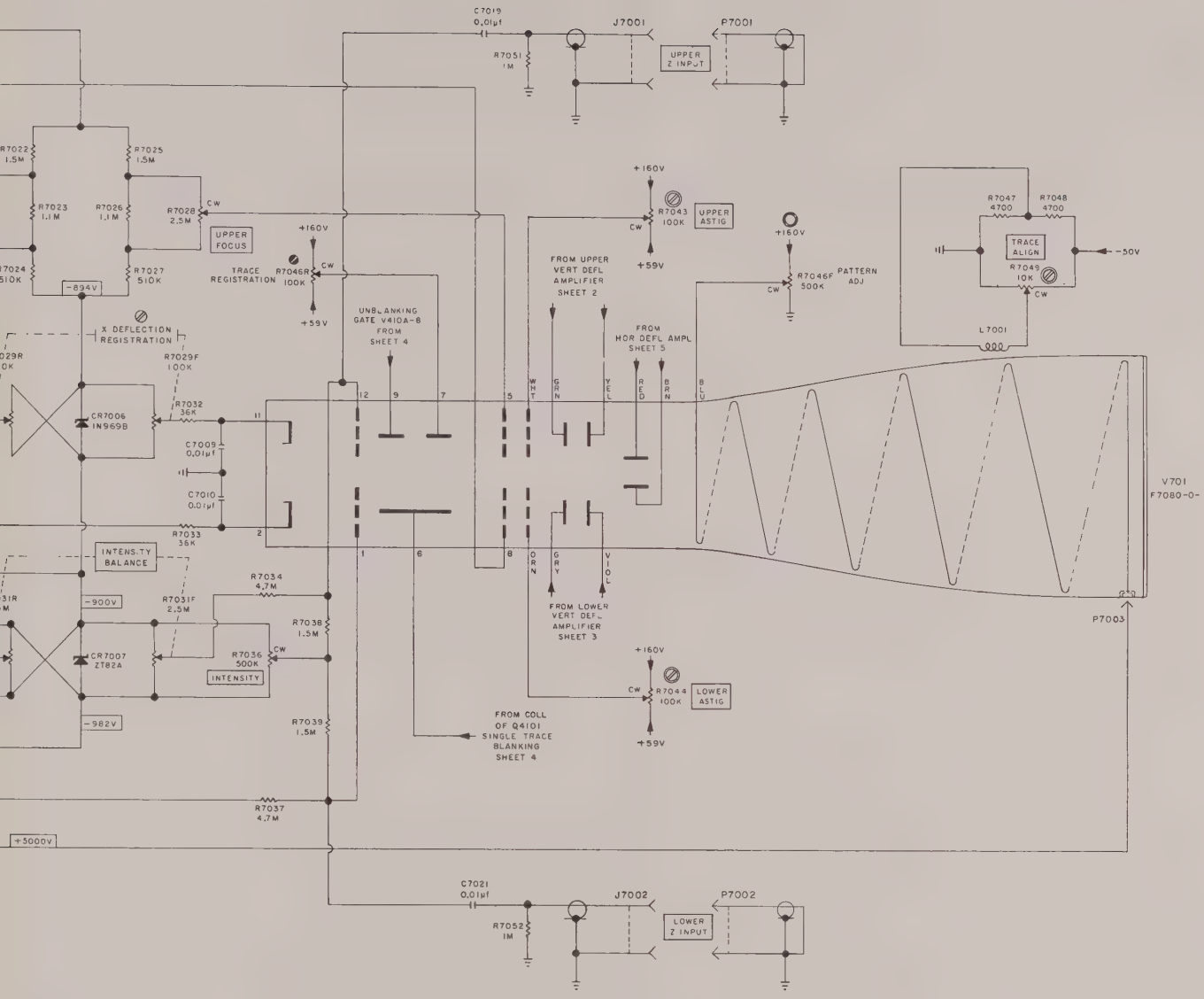
3. Voltage tolerance ±15% with respect to ground.

WAVEFORM DATA

4. Use Type 4290 Series Probe (X10)
5. Use Type 766N Series Test Oscilloscope.
6. Waveform amplitude measurements are nominal.

NOTES:

1. RESISTANCE VALUES ARE IN OHM; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
5. HEAT SINK.



TYPE 708A
HV PWR
SUPPLY
SHEET 7 OF 7

ADDENDUM

FOR

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7151)

A. PURPOSE

The following change was made to bring the Beam Finder range into spec and to correct single shot operation.

B. PARTS LIST REVISIONS

Change resistor (R4137) value & part number

From: 4.7K, P/N 0203 0640
To: 1K, P/N 0234 8210

C. SCHEMATIC REVISIONS

1. On Schematic "Upper Beam Vert Defl Ampl", Sheet 2 of 7 change resistor (R1218) value from 15K to 27K.

2. On Schematic "Trig & Swp Ckts", Sheet 4 of 7 change resistor (R4137) value from 4.7K to 1K.

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ADDENDUM

FOR

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7152)

A. PURPOSE

The following change was made to improve the performance of the auto mode.

B. PARTS LIST REVISIONS

	Symbol	Part Number	Description
Delete:	C4008	0326 7840	Capacitor, 0.047 uf, ±10%, 200V
	C4009	0315 2970	Capacitor, 39 pf, ±10%
	R4026	0203 0540	Resistor, fixed, composition; 1.8K, 0.5W, ±5%
Add:	C4008	0326 7810	Capacitor, 0.015 uf, ±10%, 200V
	C4009	0317 5100	Capacitor, 20 pf, ±5%
	R4026	0203 0550	Resistor, fixed, composition; 2K, 0.5W, ±5%

C. SCHEMATIC REVISIONS

On Schematic for Trig. & Sweep Circuits, sheet 4, change C4008 to 0.015 ufd, C4009 to 20 pf and R4026 to 2K.

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ADDENDUM

FOR

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7151)

A. PURPOSE

The following change was made to correct for microphonics and drift of input amplifier stage.

B. PARTS LIST REVISIONS

In Section 6A Parts List make the following changes:

1. Change part number of C1001, C1003, C2001 & C2003 from 0327 3720 to 0319 1361.

2. Change part number of J1001, J1002, J2001, J2002, J4001 & J5001 from 0905 7610 to 0905 9940.

3. Change note at bottom of pages 6-1 & 6-2 to read "C1001/C1003 and C2001/C2003 are selected matched pairs".

C. SCHEMATIC REVISIONS

1. On Schematic "Upper & Lower Beam Attenuator", Sheet 1 of 7 add asterisk after symbols C1001, C1003, C2001 & C2003 and add note 3 as stated in paragraph B3.

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INSTRUMENTATION

A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

6704 7911
ECN 32,394
Sheet 1 of 1

ADDENDUM

FOR

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7151)

A. PURPOSE

The following change was made to correct for microphonics and drift of input amplifier stage.

B. PARTS LIST REVISIONS

In Section 6A Parts List make the following changes:

1. Change part number of C1001, C1003, C2001 & C2003 from 0327 3720 to 0319 1361.

2. Change part number of J1001, J1002, J2001, J2002, J4001 & J5001 from 0905 7610 to 0905 9940.

3. Change note at bottom of pages 6-1 & 6-2 to read "C1001/C1003 and C2001/C2003 are selected matched pairs".

C. SCHEMATIC REVISIONS

1. On Schematic "Upper & Lower Beam Attenuator", Sheet 1 of 7 add asterisk after symbols C1001, C1003, C2001 & C2003 and add note 3 as stated in paragraph B3.

FAIRCHILD
INSTRUMENTATION

6704 7911
ECN 32,394
Sheet 1 of 1

ADDENDUM

TO

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7151)

A. PURPOSE

The following change was made to center focus range.

B. PARTS LIST REVISIONS

In Section 6 Parts List make the following changes:

	Symbol	Part Number	Description
Delete	R7022/R7025	0203 4240	1.5M, 1W
	R7023/R7026	0203 1210	1.1M
	R7024/R7027	0203 1130	510K
Add	R7022/R7025	0203 1210	1.1M
	R7023/R7026	0203 1270	2M
	R7024/R7027	0203 1150	620K

C. SCHEMATIC REVISIONS

On Schematic "HV PWR SUPPLY" change the value of the following resistors as specified.

R7022/R7025	FROM	1.5M	TO	1.1M
R7023/R7026	FROM	1.1M	TO	2M
R7024/R7027	FROM	510K	TO	620K

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

6704 7891
ECN#32,392
Sheet 1 of 1

ADDENDUM

FOR

TYPE 708A DUAL BEAM OSCILLOSCOPE
(Reference Manual Part No. 6704 7152)

A. PURPOSE

The following change was made to provide wider range for differential Bal adjustment.

B. PARTS LIST REVISIONS

In Section 6A make the following changes:

	Symbol	Part Number	Description
Delete:	R1106, R1108 R2106, R2108	0203 3080	RFC 510K, 1/2W, ±5%
Add:	R1106, R1108 R2106, R2108	0236 3080	RFF 180K, 1/2W, ±5%

C. SCHEMATIC REVISIONS

On Schematics "Upper & Lower Beam Vertical Deflection Amplifiers", sheets 2 and 3 respectively, change value of R1106, R1108 and R2106, R2108 from 510K to 180K.

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